The Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database

James K. Kenyon, Krista Amey, Kathleen Moore, Michael Dunn

Pacific and Yukon Region

Technical Report Series Number 479
2007

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THE CANADIAN WILDLIFE SERVICE'S BRITISH COLUMBIA MARINE BIRD AREA OF INTEREST DATABASE

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Catalogue No. CW69-5/479E
ISBN 0-662-45477-9

This series may be cited as:

Kenyon, J.K., K. Amey, K. Moore, and M. Dunn. 2007
The Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database
Technical Report Series No. 479. Canadian Wildlife Service,
Pacific and Yukon Region, British Columbia.

Copies may be obtained from:
Canadian Wildlife Service
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5421 Robertson Road, RR #1
Delta, British Columbia
Canada, V4K 3N2

Executive Summary

The Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database (MBAOI) technical report is an update to the Canadian Wildlife Service Areas of Interest for Migratory Birds (1994). The purpose of the MBAOI report is to introduce marine planners to a comprehensive database describing marine areas with a heightened ecological value for migratory birds and to aid in the Canadian Wildlife Service's (CWS) timely dissemination of advice during marine environmental emergencies.

The report defines an MBAOI as an area warranting special attention during marine planning processes, due to an underlying ecological value of the area with respect to marine birds. Ecological value is defined as: (1) an area where an observation of large numbers of marine birds have been recorded; (2) an area where congregations of marine birds, regardless of species, are likely to occur based on identified habitat characteristics; (3) areas adjacent to known marine bird breeding locations; or (4) areas having high bird species diversity relative to other areas within the marine environment.

This report describes the MBAOI database as a regional-scale product that can be used for marine use planning, siting of marine tenures, environmental assessment of resource development proposals (e.g. oil and gas, gravel), siting and assessment of aquaculture and mariculture operations, wind turbines, and any other marine development. As well, the identification of MBAOIs can assist with First Nation treaty negotiations, integrated ocean management, emergency response to environmental emergencies (e.g. oil spills), conservation area planning, and as a foundation for producing best management practices for areas subject to marine development.

This report also contains a discussion of limitations regarding how the MBAOI database should be used, such as: (1) the use of the MBAOI database does not remove proponent obligations under the *Species at Risk Act* or the *Migratory Bird Convention Act 1994*; (2) the scale at which MBAOIs have been identified is meant to be used for regional planning, not for local planning; and (3) areas not identified as an MBAOI should not be construed as having no ecological value to marine birds as in many cases the ecological values of those locations have simply not been examined. For these reasons it is emphasized that the identification of MBAOIs does not replace site-specific environmental assessment of individual development projects.

This technical report describes the 13 datasets and the methodology used in the development of the MBAOIs which includes bird survey data, marine bird breeding colony inventories, and habitat data such as estuary locations or locations of important food sources (e.g. herring spawn). Methods for identification of MBAOIs were dependant upon the type of

dataset analyzed. Analyses included a species diversity analysis for pelagic areas of the marine environment, selection of areas with significant bird numbers in nearshore regions based on species-specific thresholds determined through expert opinion, and selection of herring spawn sites based upon expert opinion. All estuaries (as identified by the Pacific Estuary Conservation Program) and areas adjacent to breeding colonies were selected as an MBAOI.

Each MBAOI was given a spatial context within a GIS framework. Of the more than 17 million hectares of area potentially available for selection as an MBAOI, a total of 5,483 MBAOIs covering over 2.6 million hectares was identified. Identification of MBAOIs used a more robust GIS methodology than the CWS Areas of Interest (AOI) developed in 1994 did, resulting in finer scale polygons related to data. Comparison of the MBAOIs to the original AOI shows that 41% of the MBAOIs fall within the previously identified areas. Currently, only 3.83% of all MBAOIs occur within protected areas.

The MBAOI database is available from CWS with this technical report to allow users to efficiently incorporate the MBAOI database into marine planning and other such processes. The structure and function of the database is described including which attributes can be queried and limitations on scale. Detailed spatial and technical information of the MBAOI database is provided in the metadata.

Sommaire

Le rapport technique *The Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database* (MBAOI) (sites d'intérêt pour les oiseaux marins – SIOM) du Service canadien de la faune (SCF) est une mise à jour du rapport *Canadian Wildlife Service Areas of Interest for Migratory Birds* (1994). L'objet du rapport SIOM est de présenter aux gestionnaires du milieu marin une base de données globale qui décrit les aires marines à valeur écologique élevée pour les oiseaux migrateurs et d'aider le SCF à diffuser les avis en temps opportun lors d'urgences environnementales en milieu marin.

Le rapport définit un SIOM comme un site nécessitant une attention spéciale durant les processus de planification visant le milieu marin, en raison de la valeur écologique implicite de ce site pour les oiseaux marins. La valeur écologique est définie comme suit : 1) un site où de grandes quantités d'oiseaux marins ont été observées; 2) un site où il est probable que les oiseaux marins, sans égard à l'espèce, se rassemblent compte tenu des caractéristiques de l'habitat; 3) des sites adjacents à des sites de nidification connus d'oiseaux marins; ou 4) des sites à grande diversité d'oiseaux par rapport à d'autres zones du milieu marin.

Le rapport décrit la base de données SIOM comme un produit à l'échelle régionale qui peut servir à la planification visant le milieu marin, au choix des emplacements des concessions marines, à l'évaluation environnementale des projets d'exploitation des ressources (pétrole et gaz naturel, gravier, etc.), au choix et à l'évaluation des emplacements d'exploitations aquicoles, des éoliennes et de tout autre projet d'exploitation en milieu marin. De plus, l'établissement des SIOM peut faciliter les négociations des traités des Premières nations, la gestion intégrée des océans, les interventions en cas d'urgence environnementale (déversements d'hydrocarbures, etc.) et la planification des aires de conservation et servir de référence pour l'élaboration de pratiques exemplaires de gestion dans les zones sujettes aux projets d'exploitation en milieu marin.

Le rapport contient aussi une discussion sur les limites suivantes de l'utilisation de la base de données SIOM : 1) l'utilisation de la base de données SIOM ne supprime pas les obligations des promoteurs en vertu de la *Loi sur les espèces en péril* ou de la *Loi de 1994 sur la convention concernant les oiseaux migrateurs*; 2) l'échelle des SIOM doit servir à la planification régionale et non pas à la planification locale; et 3) les zones qui ne sont pas désignées comme des SIOM ne doivent pas être considérées comme des zones sans valeur écologique pour les oiseaux marins parce que dans de nombreux cas les valeurs écologiques de ces endroits n'ont simplement pas été étudiées. Il est donc important de souligner que

l'établissement des SIOM ne remplace pas l'évaluation environnementale propre au site qui est menée pour chaque projet d'exploitation.

Le rapport technique décrit les 13 ensembles de données et la méthode qui a servi à l'établissement des SIOM, qui comprend les données des relevés d'oiseaux, les inventaires des colonies d'oiseaux marins et les données relatives à l'habitat telles que l'emplacement des estuaires ou des endroits qui sont d'importantes sources de nourriture (p. ex. les œufs de hareng). Les méthodes d'établissement des SIOM sont fonction du type d'ensemble de données analysées. Les analyses comprennent notamment l'évaluation de la diversité spécifique dans les zones pélagiques marines, la définition des zones à importants effectifs d'oiseaux dans les régions côtières à partir des seuils propres aux espèces établis par des experts et la définition des zones de concentrations d'œufs de hareng déterminées par des experts. Les estuaires (tels que définis par le Programme de conservation des estuaires du Pacifique) et les zones adjacentes aux colonies d'oiseaux nicheurs ont été retenus comme SIOM.

On a attribué à chaque SIOM un contexte spatial à l'intérieur d'un cadre SIG. Sur plus de 17 millions d'hectares éventuellement disponibles pour être retenus comme SIOM, on a défini 5 483 SIOM couvrant plus de 2,6 millions d'hectares. Pour établir les SIOM, on a utilisé une méthode SIG plus solide que celle qui a servi à définir les sites d'intérêt (SI) du SCF élaborés en 1994, ce qui a produit des polygones de données à une échelle plus fine. La comparaison des MBAOI et des SI originaux montre que 41 % des SIOM sont situés à l'intérieur des SI déjà établis. Actuellement, seulement 3,83 % des SIOM sont situés dans des zones protégées.

La base de données SIOM et le rapport technique qui sont disponibles au SCF permettent aux usagers d'intégrer efficacement la base de données dans la planification concernant le milieu marin et d'autres processus connexes. Le rapport décrit la structure et la fonction de la base de données, notamment les attributs qui peuvent être interrogés et les limites de l'échelle. Les métadonnées fournissent l'information spatiale et technique détaillée sur la base de données SIOM.

Acknowledgements

Many groups and individuals lent their support to this project over the years in many different ways. Financial support was generously provided by the Canadian Wildlife Service, Ducks Unlimited Canada, the Pacific Coast Joint Venture, and the Georgia Basin Action Plan. Data were acquired from various sources inside and outside of the Canadian Wildlife Service with a number of people and organizations lending their knowledge and expertise to this project. These people and organizations include Trudy Chatwin of the British Columbia Ministry of Environment, Bruce McCarter of the Department of Fisheries and Oceans, Tasha Smith and Peter Davidson of Bird Studies Canada, and Ducks Unlimited Canada.

Canadian Wildlife Service biologists and research scientists contributed their expertise of birds along the British Columbia coast to this project as well as providing constructive criticism and advice throughout the project. Biologists and research scientists included Ken Morgan, Rob Butler, Doug Bertram, Sean Boyd, André Breault, Mark Hipfner, and Moira Lemon. Patrick O'Hara of the Institute of Ocean Sciences and University of Victoria provided statistical advice.

A large amount of GIS support was required to prepare and assemble the database. Steven Shisko and Jason Komaromi aided in development of early versions of the database. Barry Alleyne, Stephen Jollymore, Carrie Robb, Anders Wong, and Michael Wang aided in production of the database and creation of map figures.

Previous versions of this technical report were reviewed by Laura McFarlane-Tranquilla.

Table of Contents

Executive Summary iii
Sommaire v
Acknowledgements vii
List of Tables ix
List of Figures x
1 Introduction 1
1-1 Context of the Marine Bird Area of Interest Database 1
1-2 Using the Marine Bird Area of Interest Database 2
1-3 History of the Marine Bird Area of Interest Project 2
1-4 Study Area 4
1-5 Species in the Marine Bird Area of Interest Database 4
1-6 Habitats Important to Marine Birds 4
2 Methods for Creating the Marine Bird Area of Interest Database 5
2-1 Source Data 5
2-2 Selecting Marine Bird Areas of Interest 7
2-3 Creating Marine Bird Area of Interest Polygons 15
2-4 Database Creation and Use 18
3 Limitations 18
4 Summary of the Marine Bird Area of Interest Database 21
4-1 Marine Bird Area of Interest Locations 21
4-2 Survey Coverage in Relation to Marine Bird Area of Interest Polygons 23
4-3 Comparison of the Marine Bird Area of Interest Polygons to the Areas of Interest Polygons 23
4-4 Conservation Status of Marine Bird Areas of Interest 27
5 Conclusions and Future Directions 29
References 31
Appendix 1: References Used to Create the Areas of Interest 33
Appendix 2: Selected Review of Outcomes from Previous Uses of the Marine Bird Area of Interest Database 43
A.2-1 Conservation Initiatives 43
A.2-2 Environmental Emergencies (1994 to present) 50
Appendix 3: Species Included in the Marine Bird Area of Interest Analysis 51
Appendix 4: Species Excluded From the Marine Bird Area of Interest Analysis 55
Appendix 5: Marine Bird Area of Interest Metadata 57
Appendix 6: Seasonal Coverage of the Marine Bird Area of Interest Datasets 78
Appendix 7: Spatial Coverage of Datasets Included in the Marine Bird Area of Interest Database 87
Appendix 8: Ecoregion Classification of British Columbia 102
Appendix 9: Marine Bird Area of Interest Locations 103

List of Tables

Table 1: List of datasets used to develop the MBAOI database. Source indicates the organization that is primarily responsible for collecting and maintaining the dataset. Acronyms used include CWS (Canadian Wildlife Service), BSC (Bird Studies Canada), DUC (Ducks Unlimited Canada), MOE (British Columbia Ministry of Environment), DFO (Department of Fisheries and Oceans), and PECP (Pacific Estuary Conservation Program). 6

Table 2: Abundance thresholds needed to be met in order for a record to be selected as an MBAOI. 11

Table 3: Species at risk according to the Canadian *Species at Risk Act* and International Union for Conservation of Nature and Natural Resources (IUCN) found within the Pelagic Bird Data category for selecting MBAOI records. Any species not listed in this table are considered to be of Least Concern by IUCN and have been assigned a score of zero (0). 14

Table 4: Buffer distances used for each dataset to create MBAOI polygons. 16

Table 5: List of buffer sizes assigned to colonial nesting seabirds in British Columbia. 17

Table 6: Summary of the number of MBAOI records and the area covered by MBAOI polygons from each dataset 21

Table 7: MBAOIs occurring in protected areas. 27

Table A1: Parks created under the Protected Areas Strategy (1991-2000) which overlaps with AOI 44

Table A2: Number of coastal British Columbia Important Bird Areas (IBA) and the number of IBA derived from the AOI 45

Table A3: Overlap between parks and protected areas created under the Lower Mainland Nature Legacy program and Areas of Interest (1994). 46

Table A4: Overlap between the AOI and the Pacific Estuary Conservation Program conservation projects up to 2004. 47

Table A5: Georgia Basin Ecosystem Initiative identified sites of high biodiversity and conservation values that overlap with the AOI. Many of these sites have also been identified as Important Bird Areas or Wildlife Management Areas 48

List of Figures

Figure 1: Location of the Canadian Wildlife Service Areas of Interest for Migratory Birds (1994).....3

Figure 2: Location of MBAOI polygons in British Columbia. 22

Figure 3: Spatial coverage of datasets used to identify MBAOIs. 24

Figure 4: Comparison of the extent of survey coverage from multiple datasets for a region with the MBAOIs that were identified from these datasets. 25

Figure 5: Overlap between the marine portion of the AOI and the MBAOI.....26

Figure 6: MBAOIs that are currently found within protected areas.....28

1 Introduction

1-1 Context of the Marine Bird Area of Interest Database

The *Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database* (MBAOI) was designed to provide marine planners in British Columbia with a comprehensive database describing marine areas possessing heightened ecological value for migratory birds and to aid the Canadian Wildlife Service (CWS) in dissemination of advice during marine environmental emergencies.

The MBAOI database is a Geographic Information System (GIS) tool that compiled and synthesized existing, primarily CWS, migratory bird surveys and habitat features. Since the inception of its predecessor, the CWS Areas of Interest for Migratory Birds in British Columbia (1994) (hereafter referred to as AOI), there has been a rapidly expanding need for a science-based database that is geo-spatial and able to produce digital outputs at a regional scale. For example, a database identifying sites of significant bird numbers is a key tool for highlighting the potential for, and possible magnitude of, conflicts between birds and marine development. The MBAOI database can assist with marine use planning and environmental assessment of resource exploration and extraction (e.g. oil and gas, gravel), siting and assessment of aquaculture and mariculture operations, wind turbines, and many other marine developments. This product can also assist with treaty negotiations, integrated marine management (e.g. Pacific North Coast Integrated Management Area), emergency response to marine environmental disasters (e.g. oil spills), conservation area planning (e.g. identifying marine protected areas), and producing best management practices for areas subject to marine development.

An MBAOI is defined as an area warranting special attention during the marine planning process, due to an underlying ecological value of the area with respect to marine birds. The ecological value of an MBAOI is defined by one of the following four criteria: (1) an area where a large number of marine birds has been observed at least once, (where 'large number' is defined as a predetermined threshold value for each species or species group); (2) an area where a significant number of marine birds, regardless of species or species group, is likely to congregate based on identified habitat characteristics such as foraging areas or areas of refuge during certain stages of a bird species' annual cycle (e.g. estuaries or herring spawn locations); (3) areas adjacent to known breeding locations or colonies; or (4) an area identified as having a high species diversity value relative to other areas of the marine environment.

Because of the greater spatial rigor and creation of a database afforded during the GIS update process and its exclusive marine focus, the database has been renamed from *CWS*

Areas of Interest for Migratory Birds in British Columbia (1994) to *The CWS British Columbia Marine Bird Area of Interest Database (2007).*

Precautionary Note to Users

The MBAOI database is a geo-spatial summary of areas with heightened ecological value to birds. However, **users must still exercise due diligence** in their planning processes with respect to migratory birds. It is highly recommended that the user read this document in its entirety to properly employ the MBAOI database as a planning tool. A detailed description of limitations can be found in Section 3.

1-2 Using the Marine Bird Area of Interest Database

The MBAOI database is a complex database with many potential applications. Each MBAOI displays information as a polygon (polygons are the spatial representation of data on a GIS map). Each polygon has attributes describing the bird/habitat value that led the polygon to be selected as an MBAOI. It is not expected every user of the MBAOI will be proficient in the use of this type of database or GIS. Accordingly, in order to facilitate the use of the MBAOI database, this document describes the structure and construction of the database, provides directions on its use (Section 2-4), includes summary statistics on MBAOI polygons in British Columbia's marine environment, and reviews different applications of the MBAOI database to date.

1-3 History of the Marine Bird Area of Interest Project

With the announcement of the British Columbia Protected Area Strategy in 1991, the demand for CWS knowledge regarding migratory birds was heightened. By 1992, a preliminary identification of areas of interest was accomplished to ensure CWS input into the British Columbia Protected Areas Strategy. In 1993, an in-house workshop involving staff and researchers was held at the CWS offices in Delta, British Columbia. During this workshop, CWS staff provided published, unpublished, and anecdotal information about marine and terrestrial areas known to have significant migratory bird values in British Columbia (See Appendix 1 for contributing Technical Reports, Occasional Papers, and Special Publications). This included information on species, habitat use, and seasonality. Areas were outlined as geographic features on paper maps (e.g. bathymetry and watershed boundaries). These areas were subsequently digitized to a common 1:250,000 basemap scale (Figure 1). The written sources used for the identification and verification of these areas were CWS Technical Reports and Occasional Papers, unpublished field notes and aerial survey notes (Appendix 1). The resulting

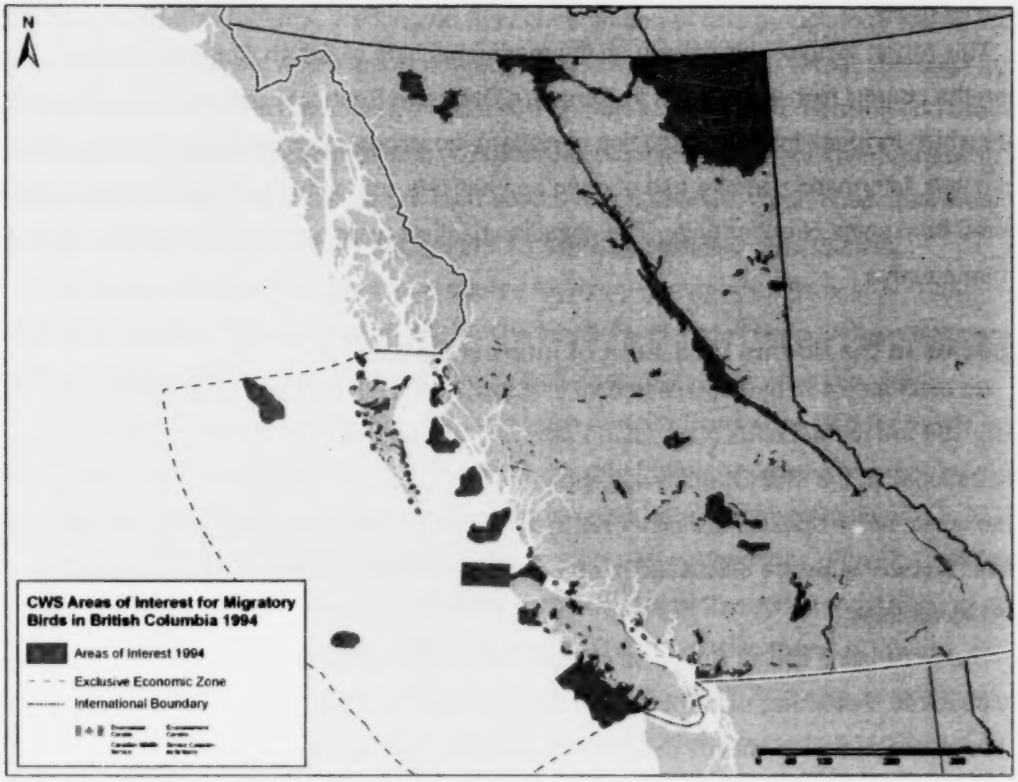
N
CWS Areas of Interest for Migratory Birds in British Columbia 1994
Areas of Interest 1994
Exclusive Economic Zone
International Boundary

Figure 1: Location of the Canadian Wildlife Service Areas of Interest for Migratory Birds (1994).

AOI polygons were formally used by CWS for input to the BC Protected Areas Strategy process, the Important Bird Areas candidate areas process, First Nations treaties, statement of interests for the Commission on Resources and the Environment processes, and for pre-assessment information for spill reports. Appendix 2 provides details on the uses and outcomes of the AOI and prototypes of the MBAOI within planning initiatives since the early 1990's. In all uses, the AOI was qualified as an initial attempt to identify Areas of Interest, and in need of further delineation.

In the years following the initial development of the AOI, CWS datasets were digitized for resource analysis. By 2001, enough datasets were available digitally to update and refine the AOI using a Geographic Information System (GIS). It was decided that the marine and nearshore components of the AOI database should be the first priority for updating and upgrading, in order to (1) confirm the value of the original areas with actual data and (2) identify new areas of interest for marine birds.

1-4 Study Area

This report focuses exclusively on the marine habitats of British Columbia found between the coastal high water mark to Canada's Exclusive Economic Zone 200 nautical miles offshore which includes inshore (including coastline), nearshore, and offshore components of the open sea. Information on bird use of open sea habitats comes from pelagic seabird surveys conducted from ships of opportunity. The coastline habitats were surveyed by ground, boat, and aerial bird surveys.

1-5 Species in the Marine Bird Area of Interest Database

An estimated 488 bird species occur in British Columbia (Ministry of Environment 2006). Of these, 161 are marine birds (Canadian Parks and Wilderness Society 2005), and of these, 130 are included in the MBAOI analysis (Appendix 3). Due to the nature of the surveys or methodologies, some species are either not included or are under-represented in the MBAOI database. These issues are discussed in detail in the methods (Section 2-1) and limitations (Section 3) sections.

The birds using British Columbia's marine environment (collectively called 'marine birds') include seabirds, waterfowl, shorebirds, and other waterbirds. Seabirds include those species which breed on British Columbia's coastal islands during the summer months and use the marine waters during other parts of the year. The seabird group includes auklets, murrelets, puffins, murres, guillemots, storm-petrels, gulls, and cormorants. This group also includes visitors and migrants, such as albatrosses, shearwaters, petrels, jaegers, skuas, and terns that nest elsewhere and visit British Columbia waters, primarily outside of their specific breeding seasons. Some species, however (e.g. albatrosses that nest in the Hawaiian Islands), make foraging trips to British Columbia waters during their breeding season. The waterfowl group includes geese, swans, and dabbling and diving duck species. The waterbird group includes loons, grebes, and waders.

1-6 Habitats Important to Marine Birds

Habitats considered important to marine birds in British Columbia include estuaries, sandy beaches, rocky shorelines, coastal islands, and nearshore, inshore, and offshore waters.

Estuaries are among the most productive habitats in the world (Mann 1982 as cited in CWS 2003) and in combination with tidal mudflats are important habitats for waterbird species. Estuaries and mudflats, and associated fringe vegetation, provide foraging and nesting opportunities for waterbirds, waterfowl and shorebirds. Eelgrass beds in estuaries, especially those that support spawning Pacific herring (*Clupea harengus pallasi*), are heavily used by

resident and migrant waterbirds, profiting on the concentration of energy-rich food (CWS 2003). Estuaries, coastal marshes, and shallow nearshore and deeper offshore waters are used by overwintering waterfowl and support significant bird numbers during their moulting and breeding seasons and during herring spawn events (CWS 2003). Annelids and other invertebrates in these estuarine habitats are an important food source for shorebirds. Open coast freshwater discharges are used extensively by gull species for bathing, preening, and drinking.

Herring spawn is an important food source for many bird species (Hay *et al.* 1989, Bishop and Green 2001, Rodway *et al.* 2003). The locations of large herring spawn sites are predictable from year to year, making them important staging areas for migrating birds.

Sandy beaches are important to gulls and terns and are used as night time roosts and migratory staging areas. Sandy and rocky beaches provide foraging opportunities for Great Blue Herons, as well as important migratory staging and foraging areas for shorebirds (CWS 2003).

Rocky shorelines and islands are used as seabird nesting locations primarily between April and September. Seabird breeding habitat may be degraded through introductions of non-native mammalian predators (such as rats and raccoons) and intrusive forms of human disturbance (e.g. logging and recreational activities such as boating). Because seabirds are sensitive to disturbance, it is critical that breeding colonies receive adequate protection (CWS 2003).

In the nearshore, inshore, and offshore marine waters, the distribution of most pelagic seabirds is dictated by the coupling of biological and physical processes that promote production of their prey. Pelagic predators, which include seabirds, tend to aggregate over static bathymetric features such as seamounts, reefs, shelf breaks, and submarine canyons that promote production and aggregation of planktonic prey and small forage fish. Oceanographic features such as fronts and eddies can also enhance predator foraging opportunities by concentrating prey and making prey accessible (CWS 2003).

2 Methods for Creating the Marine Bird Area of Interest Database

2-1 Source Data

The MBAOI database is derived from primarily CWS data found in published (i.e. Zydelis *et al.* 2005) and unpublished reports, from personal communications, and from CWS datasets that contain habitat data and survey data of bird distribution and abundance (see Table 1 for a list of referenced datasets). To be incorporated into the MBAOI identification analysis, a dataset had to cover a large region. Datasets that were limited to local sites, such as an estuary or sound, were not included as these datasets did not allow for the broad spatial comparisons

Table 1: List of datasets used to develop the MBAOI database. Source indicates the organization that is primarily responsible for collecting and maintaining the dataset. Acronyms used include CWS (Canadian Wildlife Service), BSC (Bird Studies Canada), DUC (Ducks Unlimited Canada), MOE (British Columbia Ministry of Environment), DFO (Department of Fisheries and Oceans), and PECP (Pacific Estuary Conservation Program).

Dataset Category	Dataset Name	Description	Source	Temporal Coverage	Scale	Data Type
Category #1 (Nearshore Bird Data)						
	Coastal Waterbird Inventory	Compilation of many surveys	CWS, DUC, MOE	1907-1993	1:250,000	Line
	Coastal Waterbird Survey	Bird Studies Canada winter surveys	BSC	1999-2005	1:250,000	Polygon
	Moulting Seaducks	Summer aerial survey	CWS	1998	1:525,000	Point
	North Island Straits Spring Waterbird Survey	Replicated aerial surveys	CWS	2004	1:250,000	Line
	Pelagic Seabird Survey	Ship-of-opportunity surveys	CWS	1982-2005	1:250,000	Polygon
	Seabird Ship Survey	Ship-of-opportunity survey	CWS	1998	1:250,000	Point
	Triennial Air Surveys of Trumpeter Swans	Winter surveys: Vancouver Island-Lower Mainland	CWS	1970-2002	1:250,000	Point
	Vancouver Island Marbled Murrelet study	At-sea surveys	CWS	1991	1:250,000	Line
	West Vancouver Island Waterbird Survey	Replicated spring and winter aerial surveys	CWS	1999-2000	1:250,000	Line
Category #2 (Pelagic Bird Data)						
	Pelagic Seabird Survey	Ship-of-opportunity surveys	CWS	1982-2005	1:250,000	Polygon
Category #3 (Colony Data)						
	Great Blue Heron Colony Locations	Historic colony locations	CWS, MOE	1920-2004	1:250,000	Point
	Seabird Colony Inventory	Seabird colony locations	CWS	1937-1989	1:250,000	Point
Category #4 (Habitat Data)						
	Herring Spawn	Location of herring spawn on the British Columbia coast	DFO	1928-2001	1:40,000	Point
	Pacific Estuary Conservation Program Identified Estuaries	Location of estuaries	PECP	n/a	1:20,000-1:50,000	Polygon

needed in marine planning. The selected datasets had to contain raw data, allowing the use of data that had not been summarized, averaged, or interpreted in any manner. Datasets were then grouped into four categories based on characteristics of the datasets and common analysis methods. Each category had equal priority in terms of the importance of any MBAOI records selected.

The four data categories contain much of the survey effort and habitat data for most bird species found within the marine environment of British Columbia. All records of species deemed to inhabit the marine environment were included in the analysis; however, some species are neither well-represented by traditional survey methodologies nor found in large localized congregations. For these reasons, the number of MBAOI records for some species will likely be underestimated. For example, MBAOIs for shorebirds are few because no dataset used for MBAOI selection focussed on shorebirds at a provincial scale due to the prevalence of aerial surveys that are biased against small species. As well, underestimates of MBAOI are likely for species such as roosting dabbling ducks, geese, and swans that use marine habitat at night when surveys do not occur, or diving birds, such as loons and grebes, that are known to dive at the approach of low-flying aircraft. However, some areas that are valuable to these types of species were likely identified as MBAOIs by the inclusion of datasets in the Habitat Data category.

The datasets used to create the MBAOI database sometimes contained records that were not included in the MBAOI analysis. All mammal, fish, and turtle species; opportunistic records of bird (e.g. Bald Eagle) nests (with the exception of the Seabird Colony Inventory and Great Blue Heron Colony Locations datasets) were excluded as these records were not part of any standardized survey; and species deemed to be non-marine (e.g. songbirds and most raptors) or accidental (e.g. Black Duck, King Eider). As well, any species thought to be incorrectly identified were omitted from analysis, and some count data were deemed likely to be incorrect and was subsequently dropped. Appendix 4 lists species excluded from the MBAOI analysis. Circumstances where questionable count data were dropped were duly noted within the MBAOI metadata (Appendix 5).

2-2 Selecting Marine Bird Areas of Interest

A description of the technical methodology for selecting MBAOI records can be found in the MBAOI metadata included in Appendix 5. Each category was analyzed using slightly different methodologies as described below.

Category #1 (Nearshore Bird Data)

Nine individual datasets were used in this category, covering the nearshore environment (most records within 3 km of the coast). Bird abundance was surveyed either through aerial, water, or ground surveys. These surveys had a variety of objectives and were conducted at various times throughout the year, thus impacting the type and number of MBAOI records that can be extracted (see section 3 Limitations for a further explanation). Appendix 6 displays species found in each dataset and the time of year each dataset covers. Species at risk were included in the analysis and were treated no differently from any other species. Each dataset within the "Nearshore Bird Data" category was analyzed independently of other datasets.

The following is a description of each of the nine datasets used to select MBAOI in the "Nearshore Bird Data" category. Maps depicting the spatial coverage of each of the datasets are displayed in Appendix 7. Many of the datasets had unique features that had to be accommodated during the analysis. These unique features are included in the description of each dataset below:

- ***Coastal Waterbird Inventory:***

  This dataset is a compilation of many different surveys conducted by CWS, British Columbia Ministry of Environment, and Ducks Unlimited Canada between 1907 and 1993. Surveys covered all seasons (Appendix 6) but were biased towards winter surveys. The spatial coverage of the Coastal Waterbird Inventory is the most extensive of any of the datasets within this category, and is the only bird survey dataset available for the majority of the coast north of Vancouver Island. Each survey within the Coastal Waterbird Inventory had its own objective and methodology, resulting in some surveys recording only specific species. Surveys were conducted from the air, by boat, and from the ground. Some transects within the dataset were surveyed more than once, however, this replication was not intentional therefore each record was treated independently. There were a number of long transects (maximum of 122 km) included in this dataset. Transects over 20 km were excluded from the analysis as they were not spatially explicit enough for selecting MBAOI.

- ***Coastal Waterbird Survey:***

  Bird Studies Canada initiated a ground-based, annual, replicated monthly winter survey in 1999 conducted by volunteer observers (Badzinski *et al.* 2006). Although designed as a winter survey, there are some records throughout the rest of the year. Most surveys are conducted near populated areas, particularly eastern Vancouver Island, the Lower

Mainland, and the Sunshine Coast. Records within the dataset were categorized as inland, nearshore, and offshore. Records categorized as inland were not included in the analysis while the sum of the nearshore and offshore counts were used as the total count for that transect for that survey period.

- ***Moulting Seaducks:***

  This dataset is of a one-time only aerial survey conducted in August 1998 along the mainland coast from mid-Vancouver Island north to the Canada-Alaska border by CWS. This survey was designed to cover the flightless period of the seaduck moult, particularly scoter species. The flightless moult period is an important phase in the life cycle of these birds. Although this is a one-time survey, the timing of the survey in relation to the life cycle of its intended target species made inclusion of this dataset important.

- ***North Island Straits Spring Waterbird Survey:***

  CWS conducted a replicated aerial survey of strip-transects during March, 2004 of the coastline in the North Island Straits region between northern Vancouver Island and the mainland coast. This survey was designed to coincide with both the pre-herring spawn period as well as during the herring spawn event. Only records listed as "on transect" were included as records listed as "off transect" or "spawn" were not as spatially robust.

- ***Pelagic Seabird Survey:***

  This coast wide survey, conducted aboard ships-of-opportunity, began in 1982. Ships-of-opportunity commonly consisted of oceanographic research vessels. Details regarding data collection can be found in an atlas currently being developed that documents the distribution of seabirds off the British Columbia coast (Kenyon *et al. in prep*). For the Nearshore Bird Data category, only records of pelagic seabirds within 3 km of the coast and from within the Strait of Georgia were included. However, nearshore records near the Scott Island group were assigned to Category #2 (Pelagic Bird Data).

- ***Seabird Ship Survey:***

  This dataset is of a one-time boat survey in late spring of 1998. Survey covered areas from the mid-east coast of Vancouver Island to the central mainland coast.

- ***Triennial Air Surveys of Trumpeter Swans:***

  This is a single-species survey that targets Trumpeter Swans on Vancouver Island and the Lower Mainland regions every three years beginning in 1971. Although data included

swans observed on land, only observations from marine environments were included in the analysis.

- ***Vancouver Island Marbled Murrelet Survey:***

  CWS conducted a partially replicated boat survey in June and July of 1991 along the northwest coast of Vancouver Island, through the North Island Straits, and along the east coast of Vancouver Island north of Nanaimo. Although this survey was designed for studying Marbled Murrelets, all other species were recorded.

- ***West Vancouver Island Waterbird Survey:***

  This dataset represents a replicated aerial survey of strip-transects along the west coast of Vancouver Island conducted in spring of 1999 and winter of 2000 (Zydelis *et al.* 2005). Analyses were conducted separately on the spring and winter components of the dataset, due to the variation between winter and spring counts. The spring survey was timed in conjunction with herring spawn and the spring bird migration, while the winter survey was timed to cover the resident wintering population of birds. Bird numbers were assigned to multiple transects for some replicates requiring some transects to be combined spatially so that any MBAOI selected would represent the area that the bird record corresponded to. Please see the metadata for the MBAOI found in Appendix 5 for more details. Similar to the North Island Straits Spring Waterbird Survey, only records listed as "on transect" were included in analysis while records listed as "off transect" and "spawn" were excluded.

To extract records for designation as an MBAOI, each record was examined to determine if it met a species-specific threshold. Threshold values represent total numbers of a given species per record, and were derived via expert opinion (A. Breault, K. Morgan, and R. Butler pers. comm.; see Table 2). The threshold value is dependant upon the overall distribution and abundance patterns of each species. For very rare species and species distributed in low densities, small numbers may be significant while presence of large numbers of individuals might be commonplace for an abundant species or a species with a clumped distribution. The use of threshold values was used to select MBAOIs instead of a more statistically robust methodology due to variation within and between datasets. Attempts were made to select MBAOIs based on a records' relative bird abundance compared to other records within a dataset but differences in transect size within datasets prevented comparison between records. Selecting MBAOIs via threshold values resulted in a more conservative number of MBAOI than the statistical method.

Table 2: Abundance thresholds needed to be met in order for a record to be selected as an MBAOI.

Group	Species	Abundance Threshold
Seabirds		
	Alcid Spp.	500
	Ancient Murrelet*	100
	Black-footed Albatross*	1
	Black-legged Kittiwake	150
	Cassin's Auklet	250
	Common Murre	250
	Dark Shearwater Spp.	1,200
	Fork-tailed Storm-Petrel	750
	Leach's Storm-Petrel	100
	Marbled Murrelet*	5
	Murre Spp.	250
	Northern Fulmar	150
	Parasitic Jaeger	20
	Pigeon Guillemot	35
	Pomarine Jaeger	8
	Rhinoceros Auklet	100
	Short-tailed Shearwater	750
	Sooty Shearwater*	25,000
	Tufted Puffin	25
Loons		
	Arctic Loon	5
	Common Loon	100
	Loon Spp.	100
	Pacific Loon	100
	Red-throated Loon	5
Grebes		
	Eared Grebe	20
	Grebe Spp.	100
	Horned Grebe	50
	Pied-bill Grebe	100
	Red-necked Grebe	100
	Western Grebe	100
Gulls		
	Black-headed Gull	2
	Bonaparte's Gull	5,000
	California Gull	3,500
	Caspian Tern	45
	Common Tern	100
	Franklin's Gull	2
	Glaucous Gull	3
	Glaucous- winged Gull	500
	Gull Spp.	10,000
	Heermann's Gull*	100
	Herring Gull	500
	Iceland Gull	2
	Little Gull	2
	Mew Gull	3,500
	Ring-billed Gull	500
	Sabine's Gull	100
Diving Ducks		
	Barrow's Goldeneye	200
	Black Scoter	200
	Bufflehead	200
	Canvasback	100
	Common Goldeneye	200
	Common Merganser	100
	Diving Duck Spp.	1,000
	Goldeneye Spp.	500
	Greater Scaup	500
	Harlequin Duck	200
	Hooded Merganser	50
	Lesser Scaup	500
	Long-tailed Duck	200
	Merganser Spp.	200
	Redhead	100
	Red-breasted Merganser	100
	Ring-necked Duck	500
	Ruddy Duck	200
	Scaup Spp.	1,000
	Scoter Spp.	1,000
	Seaduck Spp.	5,000
	Surf Scoter	1,000
	White-winged Scoter	500
Dabbling Ducks		
	American Wigeon	500
	Blue-winged Teal	500
	Dabbler Spp.	1,000
	Eurasian Wigeon	200
	Gadwall	1,000
	Green-winged Teal	500
	Mallard	1,000
	Northern Pintail	1,000
	Northern Shoveler	1,000
	Teal Spp.	1,000
	Wood Duck	500
Shorebirds		
	Baird's Sandpiper	25
	Black Turnstone	30
	Black-bellied Plover	1,000
	Dowitcher Spp.	100
	Dunlin	1,000
	Greater Yellowlegs	30
	Killdeer	50
	Least Sandpiper	200
	Lesser Yellowlegs	20
	Long-billed Curlew*	5
	Long-billed Dowitcher	100
	Marbled Godwit	5
	Pectoral Sandpiper	20

Group	Species	Abundance Threshold	Group	Species	Abundance Threshold
	Slaty-backed Gull	2		Phalarope Spp.	1,000
	Tern Spp.	150		Plover Spp.	1,000
	Thayer's Gull	2,000		Red Knot	10
	Western Gull	1,000		Red Phalarope	1,000
Cormorants				Red-necked Phalarope	1,000
	Brandt's Cormorant	100		Rock Sandpiper	20
	Cormorant Spp.	100		Sanderling	100
	Double-crested Cormorant	100		Sandpiper Spp.	1,000
	Pelagic Cormorant	100		Semipalmated Plover	30
Miscellaneous				Semipalmated Sandpiper	100
	American Coot	500		Sharp-tailed Sandpiper	10
	Bald Eagle	100		Shorebird Spp.	1,000
	Black Oystercatcher	10		Short-billed Dowitcher	30
	Eagle Spp.	100		Solitary Sandpiper	10
	Great Blue Heron*	20		Spotted Sandpiper	50
Swans/Geese				Stilt Sandpiper	5
	Brant	200		Surfbird	30
	Canada Goose	500		Wandering Tattler	10
	Goose Spp.	500		Western Sandpiper	1,000
	Greater White-fronted Goose	200		Whimbrel	50
	Snow Goose	500		Willet	10
	Swan Spp.	200		Yellowlegs Spp.	30
	Trumpeter Swan	200			
	Tundra Swan	200			

* Thresholds are estimated for the time period when a species is most abundant. Species with an asterisk are listed either by the *Species at Risk Act* or the International Union for Conservation of Nature and Natural Resources (IUCN) as threatened, near-threatened, or of special concern. Threshold values cannot be used for any purpose other than for selecting areas as an MBAOI.

For datasets that had replicated surveys, the maximum number of individuals observed on each transect for each species was used to determine if a transect qualified as an MBAOI. The maximum number of individuals observed per transect for each species was used because this value estimates the potential number of birds an area could support.

Species-specific threshold values, listed in Table 2, are intended only as a guide for acceptance of a record as an MBAOI. These thresholds cannot be construed as conservation targets of any kind or used for any purpose other than that intended in this document.

Category #2 (Pelagic Bird Data)

The Pelagic Seabird Survey dataset contains records from ships-of-opportunity surveys of seabirds within Canada's Exclusive Economic Zone (EEZ) dating back to 1982 as detailed in Kenyon *et al.* (*in prep*). For this category, surveys within three (3) kilometres of the coast were excluded from the analysis (and moved to the Nearshore Bird Data category). However, because this particular survey type was directed toward pelagic seabird species not likely to be found in the Strait of Georgia, surveys conducted within three kilometres of the Scott Island

group were included and all pelagic surveys conducted in the Strait of Georgia were excluded. Within these boundaries, the area was divided into 5' latitude by 5' longitude grid cells to be used as the unit for analysis. Grid cells and transects that extended into American waters were truncated at the boundary line between Canadian and American waters. Grid cells along the western boundary of Canada's EEZ were not truncated, because Canada has some jurisdiction over these areas, and because the precise location of this boundary is questionable.

A species diversity index (SDI) was chosen as the best method to identify MBAOI for the pelagic environment because species diversity, rather than raw species numbers, was deemed a better estimate of the ecological value of an area. Unlike the datasets in Category #1 (Nearshore Bird Data), the standardized manner in which the Pelagic Seabird Survey dataset was collected allowed for determination of an SDI and easy comparisons between areas. The SDI (see Kenyon *et al.* (*in prep*) for further details) consisted of three separate attributes: total bird density, species richness, and species-at-risk. The SDI was calculated for each grid cell by combining the values of these three attributes.

Total bird density was calculated as the average bird numbers per square kilometre within a grid cell. Species richness was the number of individual species observed within a grid cell. Records which were only identified to the species group level (e.g. Alcid spp.) were omitted from determining species richness, except when no individual species from within that group was identified in the grid cell. The species-at-risk value, a proxy for the number and threatened status of species within a grid cell, was calculated by summing an assigned value for each species. Values were assigned based upon the status of each species under the Canadian *Species at Risk Act* (SARA) or International Union for Conservation of Nature and Natural Resources (IUCN). Non-listed species were assigned a value of zero; species listed as "special concern" or "near threatened" were assigned a value of 1; and species listed as "threatened", "vulnerable", or "endangered" were assigned a value of 2 (Table 3). For each attribute, the value for each grid cell was converted to a score out of 1; that is, the top scoring grid cell was given a value of 1 and all other grid cells were given a proportional score relative to the top scoring grid cell (by dividing each grid cell's score by the top score). Preliminary analysis found a correlation between survey effort and the species richness and species-at-risk scores. To correct for this, a spline curve (df = 10) was fitted to the relationship and residuals were calculated.

All three scores used to calculate the SDI needed to be standardized to the same scale in order for the scores to be added together. A standardized distribution where the mean is zero and the standard deviation equals one was used. To place the total bird density scores on this

Table 3: Species at risk according to the Canadian *Species at Risk Act* and International Union for Conservation of Nature and Natural Resources (IUCN) found within the Pelagic Bird Data category for selecting MBAOI records. Any species not listed in this table are considered to be of Least Concern by IUCN and have been assigned a score of zero (0).

Species	SARA Listing	IUCN Listing	Score
Kittlitz's Murrelet		Critically Endangered	2
Black-footed Albatross		Endangered	2
Marbled Murrelet	Threatened	Endangered	2
Buller's Shearwater		Vulnerable	2
Laysan Albatross		Vulnerable	2
Pink-footed Shearwater	Threatened	Vulnerable	2
Short-tailed Albatross	Threatened	Vulnerable	2
Xantus's Murrelet		Vulnerable	2
Ancient Murrelet	Special Concern	Least Concern	1
Black-vented Shearwater		Near Threatened	1
Heermann's Gull		Near Threatened	1
Mottled Petrel		Near Threatened	1
Murphy's Petrel		Near Threatened	1
Sooty Shearwater		Near Threatened	1
Sooty Storm-Petrel		Near Threatened	1

scale, the scores were arcsine transformed and then standardized. For both the species richness and species-at-risk analyses, the residuals were standardized. For each grid cell, the sum of the three standardized values was calculated to give the species diversity index.

As the SDI was designed to have a normal distribution, there was no threshold or natural break in this distribution to develop obvious selection criteria. Therefore, expert opinion was used to assess the suitability of the resulting MBAOIs (K. Morgan pers. comm.). As a result, the top 10% highest-scoring grid cells were selected as MBAOIs as these best confirmed knowledge of actual bird distributions.

Category #3 (Colony Data)

This category contains datasets of locations of breeding birds associated with marine habitat. Marine areas adjacent to all active and historic colony locations were selected as an MBAOI due to their importance within the life cycle of marine birds. Species included within this category include: Ancient Murrelet, Black Oystercatcher, Brandt's Cormorant, Cassin's Auklet, Common Murre, Double-crested Cormorant, Fork-tailed Storm-Petrel, Glaucous-winged Gull, Great Blue Heron, Horned Puffin, Leach's Storm-Petrel, Pelagic Cormorant, Pigeon Guillemot, Rhinoceros Auklet, Thick-billed Murre, and Tufted Puffin. The Seabird Colony Inventory is a coast wide inventory of seabird colonies. Because mapped locations of Great Blue Heron

colonies are only available for Vancouver Island and the southern mainland coast, colonies located elsewhere on the coast could not be included in the MBAOI database. Not all colonies are surveyed each year; therefore colonies that were active at some point in the past may or may not be still in use. All colonies (without concrete knowledge of their present status) were included as it was concluded that inclusion of historic colonies may allow for more effective management of recovering species.

Category #4 (Habitat Data)

Not all of British Columbia's marine areas have had bird surveys conducted. Identified habitat characteristics, acting as proxies for birds, may be mapped in order to fill these spatial information gaps. Habitat characteristics with known importance to birds have been mapped for large areas of British Columbia's marine environment, (see Section 1-6 for description). All Pacific Estuary Conservation Program Identified Estuaries previously mapped in British Columbia (Ryder *et al.* 2007) were automatically selected as an MBAOI. The herring spawn index is a cumulative index representing the frequency and size of herring spawn events occurring within an approximately one kilometre stretch of shoreline as calculated by DFO (McCarter *et al.* 2005). Records from the Herring Spawn dataset ranking in the top 10% of all records based on the herring spawn index were selected as an MBAOI. The 10% threshold was chosen based upon expert opinion that those areas regularly support significant numbers of birds during the herring spawn season (A. Breault pers. comm.).

2-3 Creating Marine Bird Area of Interest Polygons

In order to provide each MBAOI with a spatial context on the marine landscape, each record was given a dataset-specific buffer. This buffer delineates the area actually observed in the survey. The buffer sizes presented in this report cannot be used for any purpose other than representing the spatial extent of an MBAOI record. The Pelagic Seabird Surveys and the Coastal Waterbird Surveys datasets were not buffered because the spatial data of these datasets had a predefined spatial context that needed no further buffering. The buffer size assigned to each dataset was determined from either the metadata associated with the original dataset or from discussions with the biologists who collected the original data (see Table 4 for the buffer size of each dataset). These buffered areas represent the MBAOI polygons. The size of each polygon does not infer level of importance for an MBAOI as all MBAOIs have equal importance.

Table 4: Buffer distances used for each dataset to create MBAOI polygons.

Dataset Category	Dataset Name	Data Type	Buffer Size (km)
Nearshore Bird Data			
	Coastal Waterbird Inventory	Line	0.5
	Coastal Waterbird Survey	Polygon	n/a
	Moulting Seaducks	Point	0.5
	North Island Straits Spring Waterbird Survey	Line	0.2
	Pelagic Seabird Survey	Polygon	n/a
	Seabird Ship Surveys	Point	0.2
	Triennial Air Surveys of Trumpeter Swans	Point	0.5
	Vancouver Island Marbled Murrelet Survey	Line	0.2
	West Vancouver Island Waterbird Survey	Line	0.2
Pelagic Bird Data			
	Pelagic Seabird Survey	Polygon	n/a
Colony Data			
	Great Blue Heron Colony Locations	Point	3
	Seabird Colony Inventory	Point	2 or 5
Habitat Data			
	Herring Spawn	Point	2
	Pacific Estuary Conservation Program Identified Estuaries of British Columbia	Polygon	0.5 or 1

Buffer distances for the Seabird Colony Inventory dataset was dependant upon the species present in the colony but not on size of the colony (Table 5). Based upon expert opinion, 2 and 5 km distances were chosen for the buffer distances (M. Hipfner and M. Lemon, pers. comm.). For multi-species seabird colonies, the buffer distance chosen was that of the species with the largest buffer present within the colony. The buffered area does not represent the entire foraging range of the species, as some of the species are known to forage up to 100 km (e.g. Cassin's Auklet; Ryder *et al.* 2001, McFarlane Tranquilla *et al.* 2005) or more (e.g. storm-petrels, Sowls *et al.* 1978, Steele and Montevecchi 1994) from the colony. Instead, the buffers describe a common use area of birds in waters close to the colony.

A 3 km buffer was placed around Great Blue Heron colonies as Butler *et al.* (1995) found this to be the average distance between a colony and foraging areas. Great Blue Herons forage within intertidal areas, therefore, polygons created from the Great Blue Heron Colony Locations dataset were restricted to intertidal areas. Total intertidal area was defined as the area overlapping an estuary or within 100 m of the provincial Terrain Resource Information Management (TRIM) shoreline within 3 km of the colony.

Table 5: List of buffer sizes assigned to colonial nesting seabirds in British Columbia.

Species	Buffer Size (km)
Ancient Murrelet	5
Black Oystercatcher	2
Brandt's Cormorant	2
Cassin's Auklet	5
Common Murre	5
Double-crested Cormorant	2
Fork-tailed Storm-Petrel	5
Glaucous-winged Gull	2
Horned Puffin	5
Leach's Storm-Petrel	5
Pelagic Cormorant	2
Pigeon Guillemot	2
Rhinoceros Auklet	5
Thick-billed Murre	5
Tufted Puffin	5

The MBAOI polygon boundaries were terminated at the TRIM shoreline at a scale of 1:20,000 for all datasets except the Pacific Estuary Conservation Program Identified Estuaries of British Columbia dataset. The goal of the PECP project was to capture all estuarine areas potentially having significant ecological values; excluding the upland (supratidal) portions of this dataset would remove relevant portions of this dataset. The Pacific Estuary Conservation Program Identified Estuaries of British Columbia dataset was buffered seaward 500 m to approximate the usage of the subtidal areas by birds, particularly during low tides. However, four estuaries (Fraser River, Nicomekl/Serpentine River complex, Nass/Ksi'Hlginx/Burton/ Iknouck/Chamber/Kincolith River complex, and Skeena/Ecstall/McNeil River complex) were buffered 1,000 m to better estimate likely areas of significant bird numbers due to their size and complexity.

The terrestrial portion of seabird colonies is important. However, since the MBAOI database deals with the marine environment only, the terrestrial area was not included as part of the defined area for seabird colonies. The objective of this is not to explicitly define the terrestrial portion of seabird colonies but rather to inform the user of the database of the presence and general location of seabird colonies.

Some datasets contained records with spatial locations that were entirely on land, even after buffering. This was caused by a discrepancy in transferring data points from coarse-scale field maps to fine-scale GIS basemaps, a typographical error in a point's coordinates, or a

record being associated with a freshwater habitat (e.g. some colonial nesting birds). These points were excluded from the analysis.

2-4 Database Creation and Use

A digital version of the MBAOI database, housed as a geodatabase, is available from CWS upon request. The MBAOI database can be used with software programs such as Microsoft Access or ArcGIS.

Each MBAOI was assigned a unique identifier consisting of a combination of an abbreviated dataset name and the original record number. Each MBAOI was assigned to an ecoregion (Demarchi 1995) to facilitate spatial querying of MBAOI polygons (see Appendix 8 for a description of ecoregions). Any MBAOI that extended across one or more ecoregions was assigned to the ecoregion where the majority of the MBAOI resided.

The MBAOI database consists of a single geospatial table where each record has its own polygon. When displayed spatially, selection of a polygon(s) will reveal what species/ habitat feature, what dataset, what season, and the threshold value that is associated with that polygon. The MBAOI database is best suited for spatial querying to highlight MBAOIs within a region. For example, a user can identify all MBAOIs within some distance from a point of reference or overlapping a planning region. Once relevant MBAOIs have been selected based on their spatial attributes, queries can be conducted to determine which MBAOIs are relevant to a season. In some instances, there are identical polygons due to a transect or point in the original datasets having multiple species records that meet the threshold for being selected as an MBAOI. Due to the non-relational structure of the MBAOI database, spatial querying will select all overlapping polygons with their associated attributes.

3 Limitations

As outlined in the Precautionary Note to Users, the MBAOI database has limitations in the manner in which it can be used. These are:

- ***The database is intended for regional-scale, NOT local-scale marine use planning***

The MBAOI database was developed to provide marine planners with information on areas of high ecological value to marine birds. This database is a regional-scale product intended for strategic marine use planning or integrated management covering the entire marine environment of British Columbia. This product is recommended to be used at a scale no finer than 1:50,000 (see sub-section regarding scale below for geographic scale limitations).

- ***Use of the MBAOI database does not remove obligations to comply with relevant legislation related to marine birds***

This tool can highlight the potential for, and possible magnitude of, conflicts between marine birds and such activities as oil and gas exploration and extraction, aquaculture and mariculture operations, wind turbines, and marine exclusive use tenures. It can also assist with conservation area planning. Please note however, that use of this database for any of these purposes does not waive further obligations under the *Species at Risk Act* or the *Migratory Bird Convention Act 1994*. If any land use or marine use activities or projects are contemplated near or within any MBAOI, it is imperative that an on-site assessment be carried out to determine whether or not the proposed development will have a detrimental effect on the area's ability to support marine birds in the long term. Such an assessment is also necessary because the number of birds at individual sites may change over time in response to marine bird population fluctuations and changes in habitat conditions. CWS does not condone the further loss of valuable marine areas for migratory birds. For these reasons, CWS highly encourages site-specific assessments be carried out over at least one full seasonal cycle where a development proposal is contemplated near or within an MBAOI. As many of the populations of marine birds are in decline, the presence of valuable habitat is paramount for their continued survival. It is expected that proponents of developments will exercise due diligence in the avoidance or mitigation of impacts on marine birds and their habitats.

- ***Areas not identified as an MBAOI may still be important to marine birds but currently lack associated data to confirm their value to marine birds.***

Each MBAOI identified in this report has a heightened ecological value to marine birds. However, it must be noted that areas outside of the MBAOI polygons cannot be construed as having no value to migratory birds. It may mean that marine surveys have not been conducted in these areas and as such some areas of British Columbia's marine environment contain no data. Likewise, not all surveys have been conducted consistently throughout the year or across years, therefore, temporal shifts of species may not have been captured by all surveys. In addition, an absence of birds during a particular survey does not mean that birds are always absent from that area. New surveys are encouraged as a means of filling these knowledge gaps. Therefore it is incumbent upon any proponent of a project in the marine environment to exercise due diligence and demonstrate the value of any local area to marine birds. CWS, and likely other organizations, have other datasets with limited geographic scope that would be valuable for assessing local fine-scale significant areas to marine birds.

- ***Threshold values are NOT relevant outside this MBAOI identification process***

Many MBAOIs were chosen based upon an area's significant bird numbers. The definition of significant bird numbers is represented by the threshold value for each species (presented in Table 2). These threshold values were based upon expert opinion for the purpose of identifying areas as an MBAOI. Threshold values cannot be used for any other purpose. Threshold values are not conservation targets or minimum population sizes.

- ***There are inherent limitations to the techniques used to collect migratory bird data***

Due to the wide array of methodologies employed for collecting migratory bird data within the datasets analyzed for creating the MBAOI database, some species may have visibility or detectability biases that differ between datasets. This may lead to an underestimate in the number and/or imperfect location of MBAOI polygons for a species, or discrepancies in MBAOI polygon locations between different datasets within the same area. Examples of visibility or detectability biases are birds that dive at the approach of ships or low-flying aircraft (e.g. loons, grebes, and auks), birds that are too small to be seen from aerial surveys (e.g. many shorebirds), or cryptically coloured birds blending in with the background colours (e.g. female ducks on logs). There are also differences in scale of data collection (typically from 1:20,000 to 1:250,000) and purpose for which they were collected (e.g. swans only, wintering use etc.). While every attempt has been made to account for these inherent limitations in the data, some discrepancies may be encountered in placement of polygons as well as underestimates of total bird numbers or species present within the datasets analyzed.

- ***Scale of source data from which the MBAOIs are derived limits the accuracy of the MBAOI polygons***

Although the MBAOI polygons themselves have been geo-referenced to a 1:20,000 basemap, the source scale could be considerably coarser which will affect the positional accuracy of the polygons as depicted. Any enlargement of the polygon data beyond the source scale may result in unacceptable distortion and faulty registration with other data sets.

Despite these precautions, MBAOIs are valuable for setting strategic objectives and flagging areas with heightened ecological value to marine birds. Each MBAOI is based on the documented presence of an attribute defined to have value to marine birds; they are not outputs from a model. There is no rating of areas identified as MBAOIs and as such all MBAOIs should be treated with equal importance when used in marine planning processes. Due to the nature of marine physical and biological processes, the boundaries delineated in this database should not be considered as absolute. Best management practices will need to be applied to areas within and adjacent to any MBAOI.

4 Summary of the Marine Bird Area of Interest Database

4-1 Marine Bird Area of Interest Locations

A total of 5,483 MBAOI polygons that covered approximately 2,607,006 hectares were identified (Table 6). In many cases, there are identical polygons as the original dataset may have had multiple records for a single polygon that met the criteria for selection of a MBAOI (e.g. multi-species seabird colonies). Figure 2 shows the general location of all MBAOI polygons in the marine environment of British Columbia. Appendix 9 provides regional scale maps depicting each MBAOI.

Table 6: Summary of the number of MBAOI records and the area covered by MBAOI polygons from each dataset.

Dataset Category	Dataset Name	Number of MBAOIs	Area (ha)
Nearshore Bird Data			
	Coastal Waterbird Inventory	1,274	210,225
	Coastal Waterbird Survey	723	53,444
	Moulting Seaducks	6	466
	North Island Straits Spring Waterbird Survey	19	1,790
	Pelagic Seabird Survey	39	8,453
	Seabird Ship Surveys	79	975
	Triennial Air Surveys of Trumpeter Swans	12	801
	Vancouver Island Marbled Murrelet Survey	87	10,784
	West Vancouver Island Waterbird Survey	81	8,433
Pelagic Bird Data			
	Pelagic Seabird Survey	300	1,592,307
Colony Data			
	Great Blue Heron Colony Locations	199	26,866
	Seabird Colony Inventory	1,697	697,191
Habitat Data			
	Herring Spawn	525	117,521
	Pacific Estuary Conservation Program Identified Estuaries of British Columbia	442	117,950
TOTAL		5,483	2,607,006

* The sum of the area for each dataset does not equal the MBAOI provincial footprint of 2,607,006 ha due to overlap between polygons from different datasets.

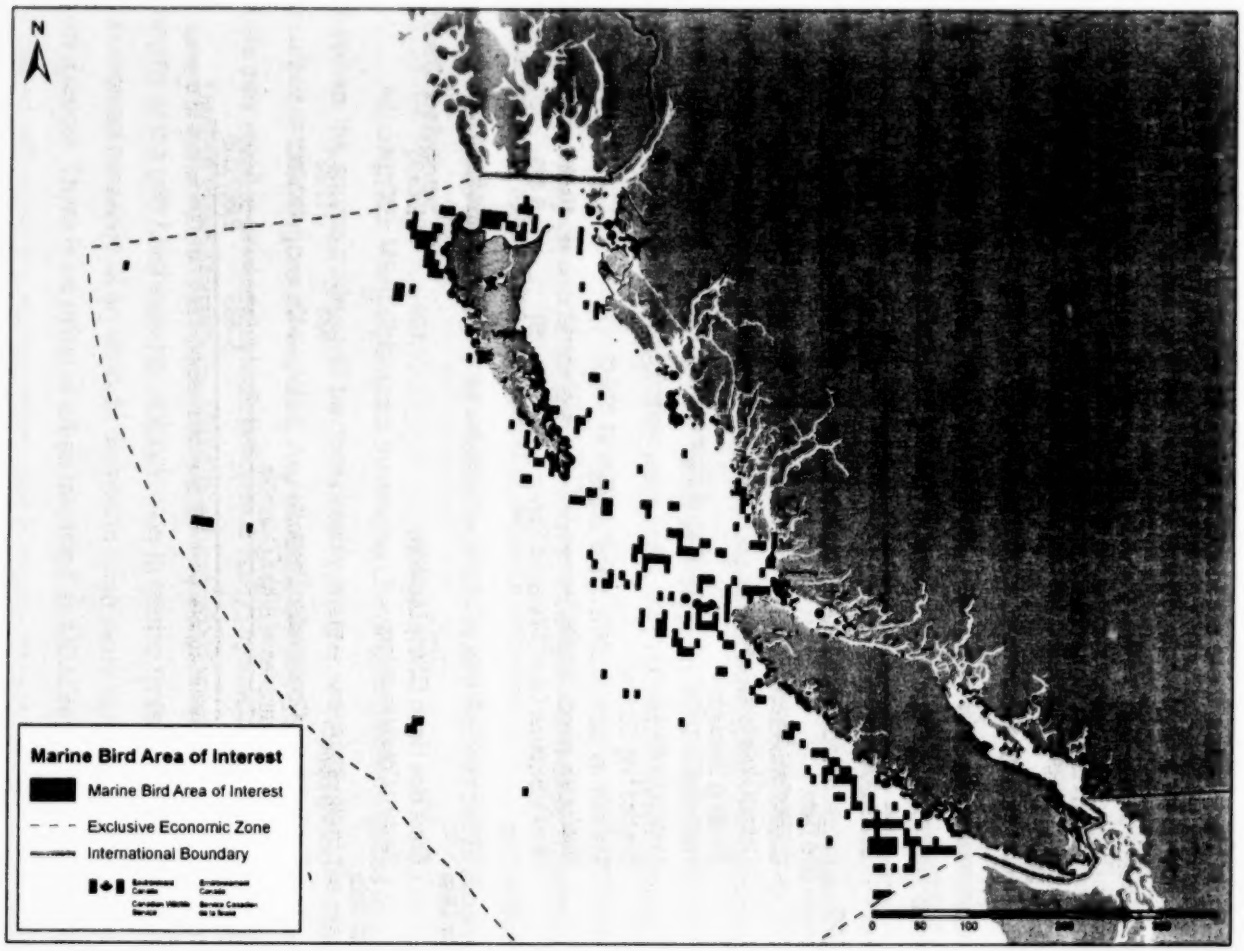

Figure 2: Location of MBAOI polygons in British Columbia.

4-2 Survey Coverage in Relation to Marine Bird Area of Interest Polygons

All datasets that were used to identify MBAOIs, after being buffered to the appropriate distance, covered more than 17,600,000 ha of marine waters (Figure 3). The total area of all of the identified MBAOIs exceeded just over 2,607,000 ha, or ~15% of the buffered dataset total area. The coverage for each individual dataset is shown in Appendix 7. Due to the small size of many MBAOI polygons, Figure 4 illustrates a small geographic area (Nigei Island on the northeast coast of Vancouver Island) showing the extent of survey coverage from a variety of datasets and the resulting MBAOI polygons that were identified from these datasets.

4-3 Comparison of the Marine Bird Area of Interest Polygons to the Areas of Interest Polygons

The identification of MBAOIs used GIS mapping to provide a more rigorous spatial analysis than used in the AOI (marine portion only). This more rigorous analysis decreased the area identified as an AOI (approximately 3.89 million hectares in the marine environment) to just over 2,607,000 ha of MBAOIs, or 67% of the original AOI extent. Approximately 1,070,733 ha, or 41%, of all MBAOIs overlap the original AOI (Figure 5). Of the 3,893,237 ha covered in the marine environment by the AOI, 27.5% was also considered an MBAOI (Figure 5). Although some of the datasets used in the AOI were also used in this analysis, many of the datasets in the MBAOI database were collected after the AOI was produced. This degree of overlap confirms many of the originally identified areas, but with a more rigorous analysis. The overlap would likely have been higher but some of the original areas have yet to be surveyed fully, or the data are not yet in a GIS-compatible format but for the most part are of localized areas.

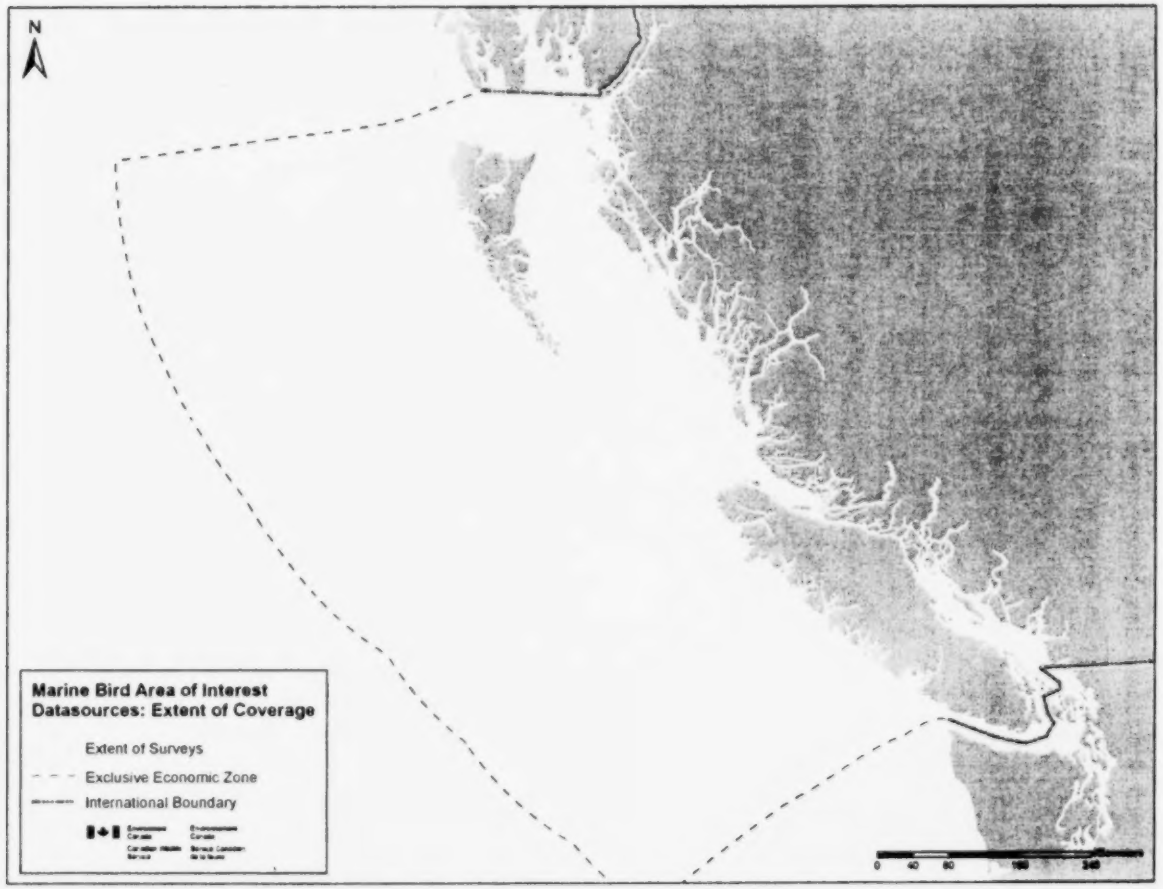

Figure 3: Spatial coverage of datasets used to identify MBAOIs. A total of 17,634,179 ha of the marine environment were surveyed and available to be selected as MBAOIs under the various criteria used. For a list of survey datasets used see Table 1.

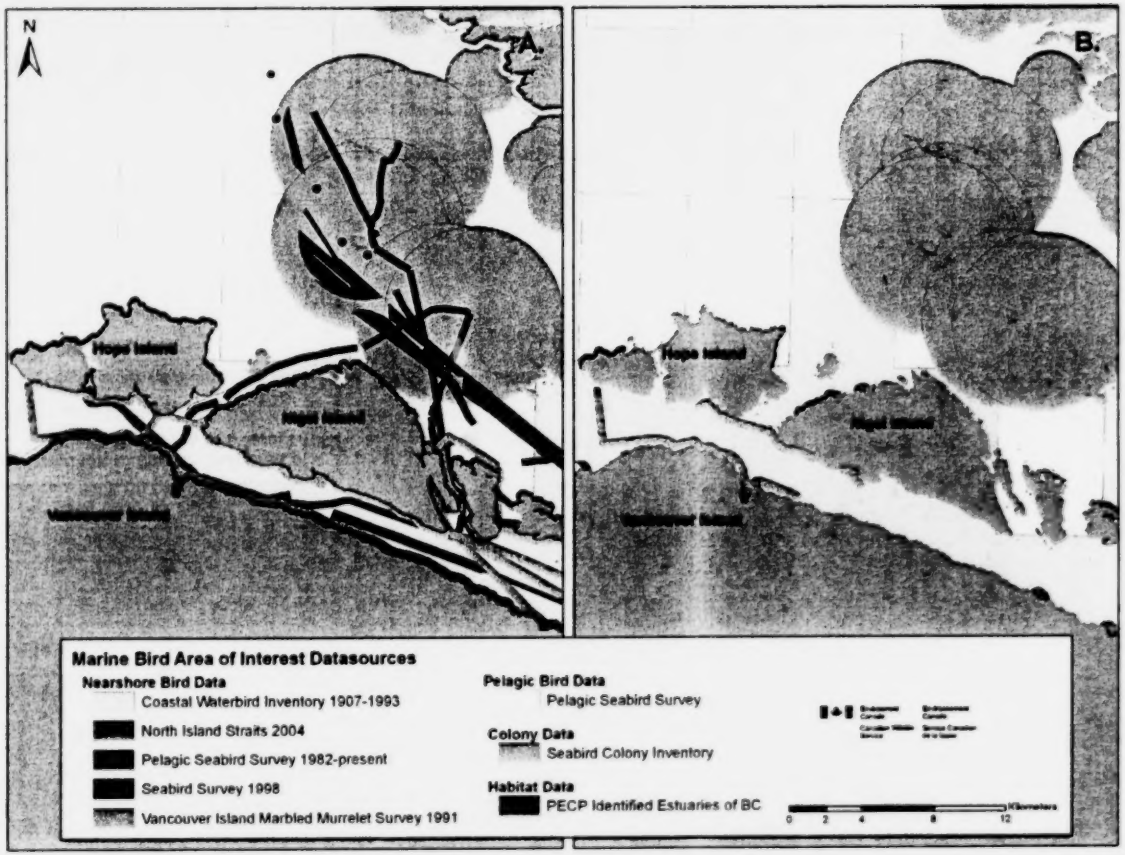

Figure 4: Comparison of the extent of survey coverage from multiple datasets for a region with the MBAOIs that were identified from these datasets. The Nigei Island region on the northeast coast of Vancouver Island is shown. Map A shows the survey coverage for each dataset, representing the area that could potentially be selected as an MBAOI. Map B shows which polygons from each dataset were identified as an MBAOI.

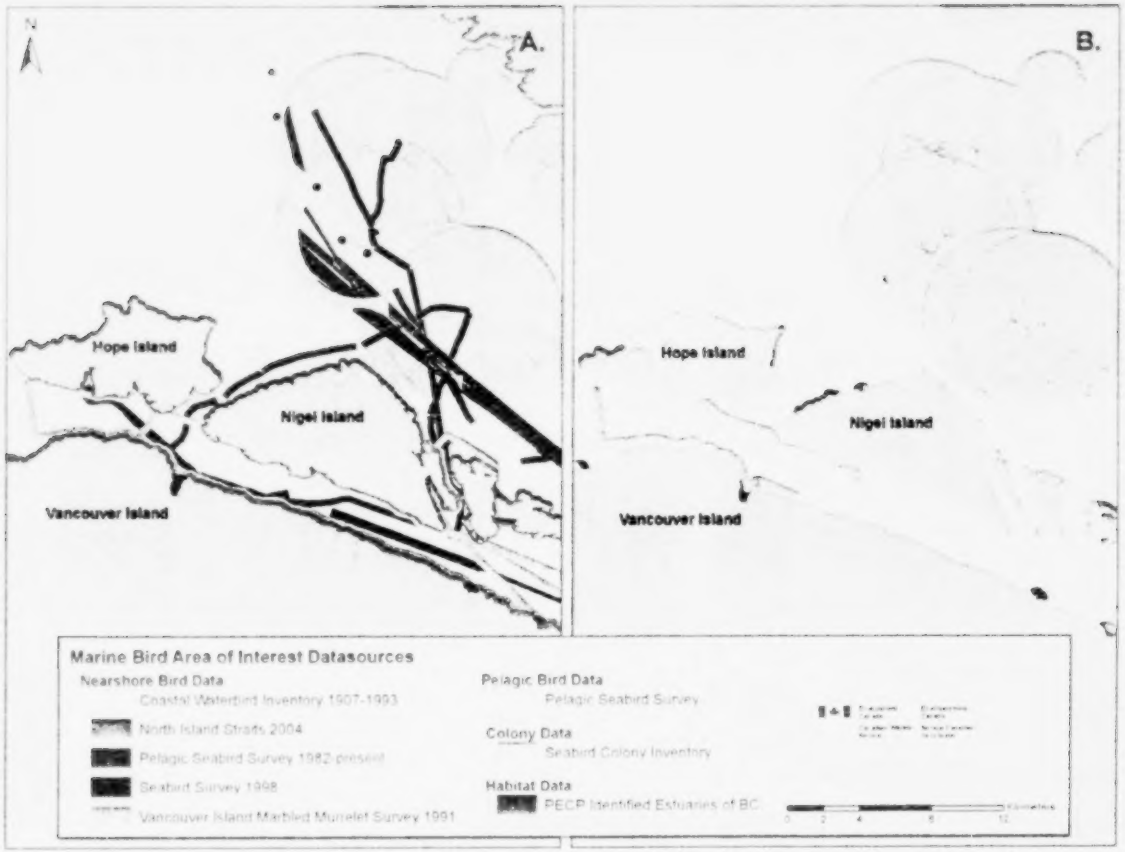

Figure 4: Comparison of the extent of survey coverage from multiple datasets for a region with the MBAOIs that were identified from these datasets. The Nigei Island region on the northeast coast of Vancouver Island is shown. Map A shows the survey coverage for each dataset, representing the area that could potentially be selected as an MBAOI. Map B shows which polygons from each dataset were identified as an MBAOI.

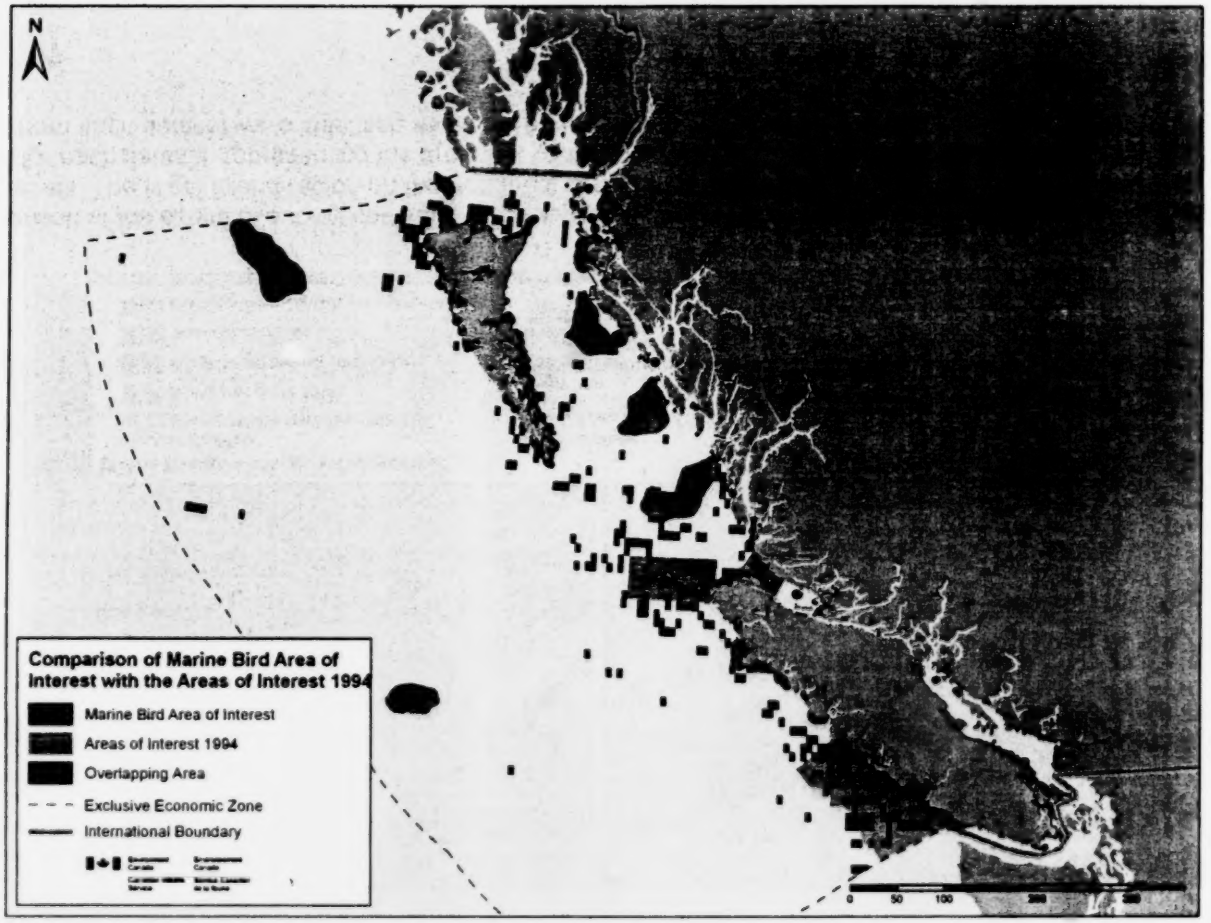

Figure 5: Overlap between the marine portion of the AOI and the MBAOI. Approximately 1,070,733 ha, or 41%, of MBAOI overlaps the AOI.

4-4 Conservation Status of Marine Bird Areas of Interest

A number of the MBAOI polygons overlap with marine areas that currently have some form of protection. Protected designations include national and provincial parks, provincial ecological reserves and protected areas, and CWS National Wildlife Areas and Migratory Bird Sanctuaries. The most recent (early 2006) provincial park database was used to make these assessments, however, its recognized that there have been new areas identified for conservation (i.e. Central Coast) that will have marine components. As a result, the area of overlap provided here will change once these new areas receive formal legal designation. A total of 96,226 ha (3.83%) of MBAOIs are currently overlapping areas with some form of protection (Figure 6, Table 7). The overall area of overlap between MBAOIs and protected areas is low because of the over 11.5 million hectares currently designated with some form of protection in British Columbia, only 2% occurs within the marine environment.

Table 7: MBAOIs occurring in protected areas.

Park Type	MBAOI per Protected Area Type (ha)	Percentage of MBAOI Polygons Occurring in Existing Protected Areas
National Parks	24,396	0.97
CWS National Wildlife Area or Migratory Bird Sanctuary *	2,083	0.08
Provincial Park	19,798	0.79
Provincial Ecological Reserve	22,732	0.91
Provincial Protected Area	27,217	1.08
TOTAL	96,226	3.83

* Please note that the small area of overlap of the MBAOI polygons with the CWS National Wildlife Areas and Migratory Bird Sanctuaries is explained by the fact that very few of these CWS protected areas have marine components.

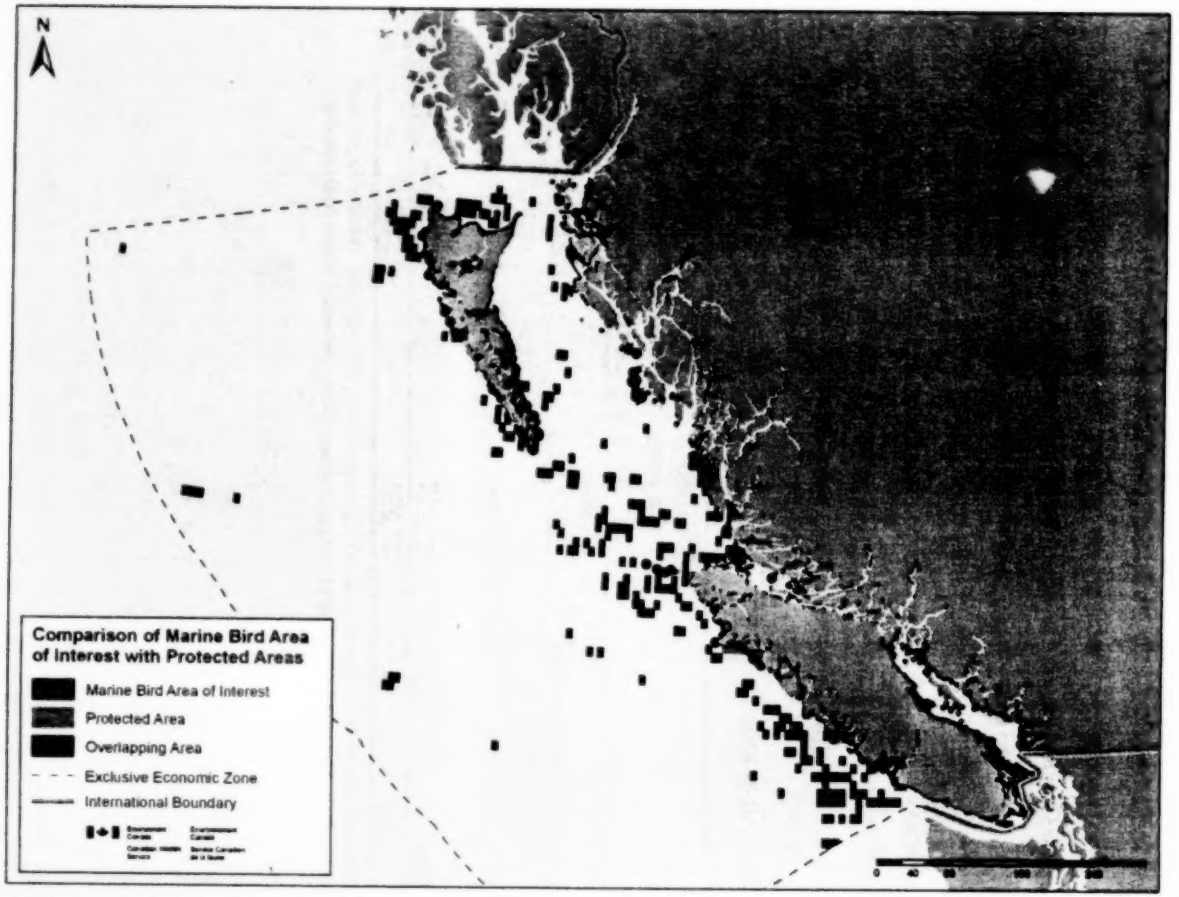

Figure 6: MBAOIs that are currently found within protected areas. Protected areas consist of national and provincial parks, provincial ecological reserves and protected areas, and CWS National Wildlife Areas and Migratory Bird Sanctuaries.

5 Conclusions and Future Directions

The identification of MBAOIs provides marine planners with CWS's contribution to the marine planning process as of 2007 through a rigorous assessment of a limited and disparate set of datasets. This product will be of use to other federal and provincial government agencies, conservation-oriented non-government agencies, First Nations, and industry as a tool for aiding in the sustainable use of the marine environment of British Columbia by flagging areas where conflict between marine development and marine birds is likely to occur. This report has outlined the many uses of the MBAOI database through documentation of historical uses, providing a detailed description of the construction of the database, and explicitly stating the limitations of the uses of the database. It is highly recommended that the entire report is read before using the MBAOI database for any purpose.

Limitations in the manner in which the MBAOI can be used and interpreted must be understood (see Section 3). This database simply identifies areas of heightened ecological value to marine birds (based on numbers and species diversity) and areas where significant bird numbers are likely to occur, based upon habitat characteristics. The MBAOIs are not meant to define protected area boundaries but instead are to contribute to general conservation area planning.

The MBAOI database offers improvements over the AOI. These improvements include a more robust GIS analysis producing finer scale polygons with associated data, a database that allows queries, and is spatially explicit to allow the database to be used by the user for their planning needs.

Future improvements in the data available for identifying MBAOIs should aim to correct limitations in the data, such as gaps in the spatial and temporal coverage, and to provide up-to-date information of bird use of the marine environment in British Columbia. More specifically, standardized, purpose-built surveys in the marine environment could allow for trend analysis, an increase in the number of MBAOIs, finer scale mapping of MBAOI boundaries, documentation of seasonal use, and possibly refinements to the analysis methods presented in this report.

Marine planning purposes would be further assisted by augmentation of the MBAOI database with updated versions of datasets included in this analysis (e.g. Pelagic Seabird Survey, Herring Spawn, Seabird Colony Inventory, Great Blue Heron Colony Locations, Triennial Air Surveys of Trumpeter Swans, and the Coastal Waterbird Survey), and by making further CWS (or other organizations') databases GIS-compatible. However, datasets collected outside CWS are often not collected using a standardized methodology, therefore, conclusions are often limited when these other datasets are used. The datasets used for creating the MBAOI

database were regional in nature; CWS owns many local scale datasets that could be used at a more site specific scale.

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Appendix 2: Selected Review of Outcomes from Previous Uses of the Marine Bird Area of Interest Database

CWS has been providing Areas of Interest-type information to various planning initiatives taking place in coastal British Columbia since 1991. The intent has always been to meet the requests for information on specific areas important to migratory birds and in turn to assist decision makers in making informed decisions. The AOI was used until 2000. After 2000, a prototype of the MBAOI was provided to certain initiatives such as the North Island Strait Marine Planning process. This section describes these opportunities whereby CWS provided input to processes that were leading to significant land allocation decisions and resulted in migratory bird habitat being prioritized or conserved. The AOI submissions were, in many cases supported by conservation partners because the AOI locations met their interests as well. There were AOI polygons, however, which exclusively met CWS migratory bird interests and which resulted in conservation areas. Although the AOI covered all of British Columbia, for the purposes of comparing to the MBAOI, this review covers only those AOI prototype (1991-1993), AOI (1994-2000), and MBAOI prototype polygons from 2001-2003 that were in coastal British Columbia (uplands and marine areas). If an overlap between an AOI or MBAOI prototype and a conservation area was found, it was assumed that the creation of that particular conservation area was influenced by the AOI or MBAOI prototype.

A.2-1 Conservation Initiatives

Protected Areas Strategy (1991-2000)

The launch of the British Columbia Protected Areas Strategy (PAS) process in 1991 and the PAS strategy itself in 1993 highlighted the need to consolidate CWS understanding of the areas of significance to birds, the areas for which there was information on birds, and the areas that were known to be significant habitats for birds and other species (e.g. Garry Oak Ecosystems).

The request for CWS input into the Commission on Resources and Environment (CORE) process helped to identify (to CWS) what needed to be done. The Commission was focused on three large planning regions with significant resource use conflicts: Cariboo-Chilcotin, Vancouver Island, and the Kootenays (East and West). With the Cariboo-Chilcotin process, CWS developed the initial process for identifying AOI areas. The process was further refined and improved in the Vancouver Island CORE process. Inputs to the Vancouver Island Land Use plan were the first to use the marine AOI dataset in a regional planning context.

Between 1993 and 1995, there were similar submissions to the Regional Protected Areas Teams (RPATs) (Goal 1 and Goal 2 candidate areas). A significant effort was undertaken to work with the Lower Mainland/Vancouver Island RPATs to detail and rate terrestrial and marine sites of importance. Other regional lists of areas of interest and importance to migratory birds, without accompanying polygons, were also provided to RPATs throughout British Columbia. Over the same period the provincial government launched its regional resource allocation planning processes called Land and Resource Management Plans (LRMPs). These were multi-scaled approaches to resource allocation planning that were to provide more detailed allocation direction to government. Each planning process was time-limited and involved large multi-stakeholder tables to reach consensus on priorities for resource allocations. Protected areas were identified through the conservation sector table and it was through CWS's input to the RPATs that the AOI came into each of these processes. In January 1994, the "Preliminary CWS Areas of Interest for Migratory Birds" for land and marine areas of British Columbia became the standardized federal protected areas interest statements to these various processes. The AOI contributed to the PAS by helping to identify major terrestrial, marine, and freshwater ecosystems, rare and endangered species, important habitats, and outstanding or unique zoological features (See Table A1).

The CORE process did not include marine areas in their deliberations and in 2000 the Province of British Columbia announced it had reached its international commitment to double parks, recreation and protected areas to 12 percent of the province (over 11.5 million hectares). Protection of marine areas has never been a specific objective of the PAS and only a small proportion (2%) of all protected areas in British Columbia occurs in the marine environment.

Table A1: Parks created under the Protected Areas Strategy (1991-2000) which overlaps with AOI.

Park	Year Established	Size (hectares)
Carmanah Provincial Park	1991	13,617
Broughton Archipelago Marine Provincial Park	1992	11,351
Flores Island Provincial Park	1993	6,372
Hesquiat Peninsula Provincial Park	1993	1,317
Sydney Inlet Provincial Park	1993	24
Vargas Island Provincial Park	1993	5,731
God's Pocket Marine Provincial Park	1995	2,019
Lanz and Cox Islands Provincial Park	1995	5,488
Lower Tsitika River Provincial Park	1995	3,634
Sulphur Passage Provincial Park	1995	1,753
Tahsish Kwois Provincial Park	1995	9,763
Juan de Fuca Provincial Park	1996	59
TOTAL		**61,128**

Important Bird Areas (1997-2001)

BirdLife International, along with its Canadian partners, Bird Studies Canada and Nature Canada works to identify and conserve a worldwide network of sites necessary to ensure the long-term viability of naturally occurring bird populations. The work to identify Important Bird Areas in Canada occurred between 1997 and 2001. The criteria used were consistent with other IBA programs around the world, and focussed on four categories: Threatened Species, Restricted Range Species, Biome-restricted/representative Species, and Congregatory Species (www.ibacanada.com). Prior to this time, the work in developing the AOI, and specifically rating some of them, had used both existing international and national criteria (Ramsar criteria Montreuse amendments, International Redbook thresholds [IUCN 2006], and CWS National Wildlife Area candidate internal selection criteria). Each AOI record was assessed for meeting the above criteria, where data were available. As such, each IBA was identified as being globally, continentally, or nationally significant to birds. Of the 68 IBAs designated in coastal British Columbia (including both marine and upland habitats), 59 (87%) were derived from AOI polygons (Table A2). Of these, 44 have globally significant numbers of birds.

An additional four AOI polygons meeting IBA criteria have been submitted but have not yet been formally identified. A further 10 AOI polygons were submitted but were rejected as not meeting IBA criteria.

Table A2: Number of coastal British Columbia Important Bird Areas (IBA) and the number of IBA derived from the AOI.

Region	Number of IBA	IBA derived from AOIs	Total Meeting Global; Continental; or National Rank	AOIs Meeting Global; Continental; or National Rank
Georgia Basin	25	18	16;1;8	14;1;3
Queen Charlotte Islands	19	18	17;1;1	16;1;1
Prince Rupert-Mainland Coast	9	9	4;0;5	4;0;5
North and West Coast of Vancouver Island	15	14	10;0;5	10;0;4
TOTAL	**68**	**59**	**47;2;19**	**44;2;13**

Lower Mainland Nature Legacy Program (1995)

In 1995, the Lower Mainland Nature Legacy (LMNL) program, a partnership of municipal, regional, provincial, and federal governments along with contributions from private donors, secured a number of significant ecological areas. The amount of dedicated parkland in

the Lower Mainland almost quadrupled. These areas became new provincial parks, new regional parks or additions to existing regional parks, or other protected areas designations. A little over 62,000 ha were protected under LMNL, and of this 12,552 ha (20%) overlapped with AOI polygons (Table A3).

Table A3: Overlap between parks and protected areas created under the Lower Mainland Nature Legacy program and Areas of Interest (1994).

Regional Parks and other Protected Areas	Size (hectares)
Barnston Island	10
Boundary Bay	142
Boundary Bay Wildlife Management Area	11,000
Brae Island	79
Colony Farm	260
Derby Reach	113
Don and Lion Islands	13
Douglas Island	187
Glen Valley and Crescent Island	77
Iona Island	133
Minnekhada	45
Poplar Island	14
Surrey Bend	359
Trim Road	58
TOTAL	**12,552**

Pacific Estuary Conservation Program (1987 to present)

The Pacific Estuary Conservation Program (PECP) is a partnership of agencies and organizations with the goal to coordinate the protection of British Columbia's coastal wetlands, farmlands, and estuaries. By 2005, the PECP had acquired over 1,400 ha of coastal upland habitat and initiated the conservation designation of another 25,000 ha of adjacent intertidal Crown lands. The AOI overlaps with 19 projects totalling 1,587 ha (Table A4).

Table A4: Overlap between the AOI and the Pacific Estuary Conservation Program conservation projects up to 2004.

Project	Year	Hectares
Widgeon Valley/Pitt River	1991	566
Englishman River	1992	55
Kumdis Bay	1992	27
Gunn and Williamson Islands	1993	41
South Arm Marshes	1993	41
Westham Farms	1994/95	58
Kitsault Estuary	1996	60
Koeye Estuary	1996	20
Westham Island Singh Farm	1997	32
Harrison River	1999	7
Kingcome Estuary	1999	135
Frenchies Island	1999	11
Nicomen Slough	2000	133
Roberts Bank Back up Lands	2000	145
Somass Estuary	2001	98
Salmon Estuary	2002	46
Craig Creek Estuary	2003	3
Little Qualicum	2003	5
Codd Island	2004	104
TOTAL		**1587**

Georgia Basin Ecosystem Conservation Partnership (2000)

The Georgia Basin Ecosystem Initiative (GBEI 1998-2003) resulted in the development of a partnership among conservation agencies and organizations to identify sites with high conservation values within the GBEI area. One partner, the Conservation Data Centre led in the development of a Catalogue of Site Records which summarized, in a standardized format, information on locations which had high biodiversity or protection values and therefore could be targeted for securement or stewardship action. A total of 135 sites were suggested by the partners and included both upland and marine areas. In total, 32 sites (Table A5) overlap with an AOI (note: all estuaries were considered to be part of the AOI but were not specifically mapped until recently).

Table A5: Georgia Basin Ecosystem Initiative identified sites of high biodiversity and conservation values that overlap with the AOI. Many of these sites have also been identified as Important Bird Areas or Wildlife Management Areas.

Site	Site
Active Pass	Horseshoe Bay
Blaney Bog	Lakemount Marsh, Fraser Valley
Boundary Bay IBA	Lambert Channel, Hornby Island
Boyle Point, Denman Island	Lazo Marsh
Burns Bog	Menzies Bay-Little River IBA
Cape Roger Curtis, Bowen Island	Mitlenatch Island IBA
Carmanah Walbran Forest	Nanaimo River Estuary
Chehalis-Harrison IBA	Parksville Qualicum WMA IBA
Chemainus Estuary	Pitt Marsh
Cowichan Estuary IBA	Pitt River mouth
Desolation Sound IBA	Quamichan Garry Oak Meadow, Duncan
Downes Point, Hornby Island	San Juan River delta
Fishtrap Creek	Sidney Channel IBA
Francis Point, Sechelt	Somenos Lake
Fraser River delta islands/foreshore	Squamish and Cheakamus Rivers
Fraser River delta, South Arm	Stave River mouth

The site catalogue was used to verify and support the ecological values of a site that had been identified as a priority for acquisition or covenant. Where a site occurred on private lands, the partners would pool resources to jointly secure the property for conservation purposes. The Georgia Basin Ecosystem Initiative explicitly identified that sites inventoried within the catalogue would be eligible for acquisition funding. This objective was further strengthened if the catalogue site also represented an AOI. The result was that many of the identified sites acquired over the period covered by the site catalogue were strongly supported by partner organizations partly because of their identification as an AOI.

Marine Planning Initiatives

At the outset, the AOI was seen as a tool for proactive regional and larger scale planning initiatives. In recent times, the provincial government launched its marine planning programs at strategic areas along the coast, such as the North Island Strait area. At the same time, Fisheries and Oceans Canada has undertaken it's Ecologically and Biologically Significant Areas (EBSA) identification process. Both of these initiatives have benefited from the use of a prototype version of the MBAOI database.

North Island Strait Marine Planning (2001-2002)

In 2001, the British Columbia government embarked on a coastal planning process for the northern part of Vancouver Island, known as the North Island Strait (NIS). The purpose of the NIS was to identify conflicts and opportunities facing the resources and communities in this area. The resulting plan provided recommendations for each marine planning unit and the permitted uses (tenures) in the foreshore and nearshore (under provincial jurisdiction). It also identified locations with recreation or conservation values where conflicting commercial or industrial tenures should not be allowed. The MBAOI database was used in this process. CWS also submitted prescriptive statements on the potential for conflict between birds and tenured/non-tenured activities.

The result was that ten NIS planning units contain areas recommended as temporary notations of interest or reserves, for the specific purpose of maintaining key values while further assessment for marine conservation and protection is completed. Options for conservation and protection management include one or more of the following designation tools: provincial marine parks or federal National Marine Conservation Areas; *Canada Oceans Act* marine protected areas; fisheries closure areas; and permanent *Land Act* reserves.

In units where allowable uses may be compatible with conservation, tenure applications are required in order to accommodate the interests of the conservation or recreation agency identified with that unit.

The NIS Planning process identified significant wildlife species and sensitive marine habitats that would be susceptible to inappropriately-located or poorly-managed tenured activities. Consequently, some of these planning units have been identified for future marine conservation or protection using a *British Columbia Land Act* notation of interest.

As a result of the above planning process, plan recommendations based upon the MBAOI prototype were:

- all bird colonies and estuaries are now automatically flagged as important to birds and must have specific referrals to CWS,
- any significant shoreline industrial or commercial development within an AOI polygon triggers a referral to CWS,
- CWS requested to formally seek designations of conservation notations on 11 of the prototype MBAOI,
- outside this process, CWS requested to formally seek designations of conservation notations on all bird colonies on vacant Crown lands, and

- commercial or recreational proposals in remote areas within an MBAOI must prepare bird plans to the satisfaction of CWS.

The NIS planning process allowed for the test of the prototype MBAOI which has also been applied to four other marine planning areas over the last 3 years: Quatsino Sound, Kyoquot Sound, Chatham Sound, and the Malaspina Complex marine use planning processes.

Ecologically and Biologically Significant Areas (2004 to present)

Ecologically and Biologically Significant Areas (EBSAs) are defined as areas with values significant enough to warrant enhanced management or reduction of risks. This process was undertaken by Fisheries and Oceans Canada nationally, but on this coast the focus has been on the central coast area (known as the Pacific North Coast Integrated Management Area [PNCIMA]). The MBAOIs were part of the PNCIMA EBSA process that resulted in the identification and ranking of Important Areas (IA) within each of the 15 EBSA areas. The final list of 132 species-related IA was developed from this process.

A comparison of the number of IA which overlap or partially overlap with an EBSA found that the highest number were the Shelf Break (16), Scott Islands (12), Chatham Sound (9), North Island Straits (8), and McIntyre Bay (8). All of these EBSA contain MBAOIs.

A.2-2 Environmental Emergencies (1994 to present)

Marine environmental emergencies, such as oil spills, require a rapid summation of information about the ecological values of a specific location, at a specific time, so that appropriate mitigative measures may be put in place. For a number of years, CWS has used the AOI polygons along with protected area boundaries to flag, in a timely manner, the presence of significant migratory bird values that must be considered when planning countermeasures. In addition, the AOI has been used in strategic planning for environmental emergencies including rating priority areas for countermeasures such as that done between Canada and the United States for events that occur in the Dixon Entrance area on the north coast of British Columbia and Juan de Fuca Strait.

Appendix 3: Species Included in the Marine Bird Area of Interest Analysis

Common and scientific names of species included in the MBAOI analysis.

Bird Grouping	Common Name	Scientific Name
Seabirds		
	Ancient Murrelet	*Synthliboramphus antiquus*
	Black-footed Albatross	*Phoebastria nigripes*
	Black-legged Kittiwake	*Rissa tridactyla*
	Black-vented Shearwater	*Puffinus opisthomelas*
	Brandt's Cormorant	*Phalacrocorax penicillatus*
	Buller's Shearwater	*Puffinus. bulleri*
	Cassin's Auklet	*Ptychoramphus aleuticus*
	Common Murre	*Uria aalge*
	Double-crested Cormorant	*Phalacrocorax auritus*
	Flesh-footed Shearwater	*Puffinus carneipes*
	Fork-tailed Storm-petrel	*Oceanodroma furcata*
	Horned Puffin	*Fratercula corniculata*
	Kittlitz's Murrelet	*Brachyramphus brevirostris*
	Laysan Albatross	*Phoebastria immutabilis*
	Leach's Storm-petrel	*Oceanodroma leucorhoa*
	Long-tailed Jaeger	*Stercorarius longicaudus*
	Manx Shearwater	*Puffinus puffinus*
	Marbled Murrelet	*Brachyramphus marmoratus*
	Mottled Petrel	*Pterodroma inexpectata*
	Murphy's Petrel	*Pterodroma ultima*
	Northern Fulmar	*Fulmarus glacialis*
	Parakeet Auklet	*Aethia psittacula*
	Parasitic Jaeger	*Stercorarius parasiticus*
	Pelagic Cormorant	*Phalacrocorax pelagicus*
	Pigeon Guillemot	*Cepphus columba*
	Pink-footed Shearwater	*Puffinus creatopus*
	Pomarine Jaeger	*Stercorarius pomarinus*
	Rhinoceros Auklet	*Cerorhinca monocerata*
	Short-tailed Albatross	*Phoebastria albatrus*
	Short-tailed Shearwater	*Puffinus tenuirostris*
	Sooty Shearwater	*Puffinus griseus*
	South Polar Skua	*Catharacta maccormicki*
	Thick-billed Murre	*Uria lomvia*
	Tufted Puffin	*Fratercula cirrhata*
	Xantus's Murrelet	*Synthliboramphus hypoleucus*
Waterfowl		
Geese		
	Brant	*Branta bernicla*

Bird Grouping	Common Name	Scientific Name
	Canada Goose	*Branta canadensis*
	Greater White-fronted Goose	*Anser albifrons*
	Snow Goose	*Chen caerulescens*
Swans		
	Trumpeter Swan	*Cygnus buccinator*
	Tundra Swan	*Cygnus columbianus*
Dabbling Ducks		
	American Wigeon	*Anas americana*
	Blue-winged Teal	*Anas discors*
	Cinnamon Teal	*Anas cyanoptera*
	Eurasian Wigeon	*Anas penelope*
	Green-winged (European) Teal	*Anas crecca*
	Gadwall	*Anas strepera*
	Mallard	*Anas platyrhnchos*
	Northern Pintail	*Anas acuta*
	Northern Shoveler	*Anas clypeata*
	Wood Duck	*Aix sponsa*
Diving Ducks		
	Barrow's Goldeneye	*Bucephala islandica*
	Black Scoter	*Melanitta nigra*
	Bufflehead	*Bucephala albeola*
	Canvasback	*Aythya valisineria*
	Common Goldeneye	*Bucephala clangula*
	Common Merganser	*Mergus merganser*
	Greater Scaup	*Aythya marila*
	Harlequin Duck	*Histrionicus histrionicus*
	Hooded Merganser	*Lophodytes cucullatus*
	Lesser Scaup	*Aythya affinis*
	Long-tailed Duck	*Clangula hyemalis*
	Redhead	*Aythya americana*
	Red-breasted Merganser	*Mergus serrator*
	Ring-necked Duck	*Aythya collaris*
	Ruddy Duck	*Oxyura jamaicensis*
	Surf Scoter	*Melanitta perspicillata*
	White-winged Scoter	*Melanitta fusca*
Waterbirds		
Loons		
	Arctic Loon	*Gavia arctica*
	Common Loon	*Gavia immer*
	Pacific Loon	*Gavia pacifica*
	Red-throated Loon	*Gavia stellata*
Grebes		
	Eared Grebe	*Podiceps nigricollis*
	Horned Grebe	*Podiceps auritus*
	Pied-billed Grebe	*Podilymbus podiceps*

Bird Grouping	Common Name	Scientific Name
	Red-necked Grebe	*Podiceps grisegena*
	Western Grebe	*Aechmophorus occidentalis*
Long-legged Waders		
	Great Blue Heron	*Ardea herodias*
Gulls and Terns		
	Arctic Tern	*Sterna paradisaea*
	Black-headed Gull	*Larus ridibundus*
	Bonaparte's Gull	*Larus philadelphia*
	California Gull	*Larus californicus*
	Caspian Tern	*Sterna caspia*
	Common Tern	*Sterna hirundo*
	Franklin's Gull	*Larus pipixcan*
	Glaucous Gull	*Larus hyperboreus*
	Glaucous-winged Gull	*Larus glaucescens*
	Heermann's Gull	*Larus heermanni*
	Herring Gull	*Larus argentatus*
	Iceland Gull	*Larus glaucoides*
	Little Gull	*Larus minutus*
	Mew Gull	*Larus canus*
	Ring-billed Gull	*Larus delawarensis*
	Sabine's Gull	*Xema sabini*
	Slaty-backed Gull	*Larus schistisagus*
	Thayer's Gull	*Larus thayeri*
	Western Gull	*Larus occidentalis*
Shorebirds		
	Baird's Sandpiper	*Calidris bairdii*
	Black-bellied Plover	*Pluvialis squatarola*
	Black Turnstone	*Arenaria melanocephala*
	Dunlin	*Calidris alpina*
	Greater Yellowlegs	*Tringa melanoleuca*
	Killdeer	*Charadius vociferus*
	Least Sandpiper	*Calidris minutilla*
	Lesser Yellowlegs	*Tringa flavipes*
	Long-billed Curlew	*Numenius americanus*
	Long-billed Dowitcher	*Limnodromus scolopaceus*
	Marbled Godwit	*Limosa fedoa*
	Pectoral Sandpiper	*Calidris melanotos*
	Red Knot	*Calidris canutus*
	Red Phalarope	*Phalaropus fulicarius*
	Red-necked Phalarope	*Phalaropus lobatus*
	Rock Sandpiper	*Calidris ptilocnemis*
	Sanderling	*Calidris alba*
	Semipalmated Plover	*Charadrius semiplamatus*
	Semipalmated Sandpiper	*Calidris pusilla*
	Sharp-tailed Sandpiper	*Calidris acuminata*

Bird Grouping	Common Name	Scientific Name
	Short-billed Dowitcher	*Limnodromus griseus*
	Solitary Sandpiper	*Tringa solitaria*
	Spotted Sandpiper	*Actitis macularius*
	Stilt Sandpiper	*Calidris himantopus*
	Surfbird	*Aphriza virgata*
	Wandering Tattler	*Heteroscelus incanus*
	Western Sandpiper	*Calidris mauri*
	Whimbrel	*Mumenius phaeopus*
	Willet	*Catoptrophorus semipalmatus*
Miscellaneous		
	American Coot	*Fulica americana*
	Bald Eagle	*Haliaeetus leucocephalus*
	Black Oystercatcher	*Haematopus bachmani*

Appendix 4: Species Excluded From the Marine Bird Area of Interest Analysis

Species and species groups found within the datasets used to create the MBAOI database that were not included in the analysis to select MBAOI. These species were deemed to be non-marine, non-native, or likely to have been misidentified.

Group	Species	Scientific Name
Birds		
	Accipiter Spp.	
	American Black Duck	*Anas rubripes*
	American Avocet	*Recurvirostra americana*
	American Bittern	*Botaurus lentiginosus*
	American Dipper	*Cinclus mexicanus*
	American Golden Plover	*Pluvialis dominica*
	American Kestrel	*Falco sparverius*
	Barred Owl	*Strix varia*
	Belted Kingfisher	*Ceryle alcyon*
	Bird Spp.	
	Black Tern	*Chlidonias niger*
	Brewer's Blackbird	*Euphagus cyanocephalus*
	Brown Creeper	*Certhia americana*
	Clark's Grebe	*Aechmophorus clarkii*
	Common Ground-Dove	*Columbina passerina*
	Cooper's Hawk	*Accipiter cooperii*
	Common Raven	*Corvus corax*
	Common Snipe	*Gallinago gallinago*
	Dark-eyed Junco	*Junco hyemalis*
	Diving Bird	
	Domestic Goose	
	Falcon Spp.	
	Ferruginous Hawk	*Buteo regalis*
	Great Black-backed Gull	*Larus marinus*
	Great Horned Owl	*Bubo virginianus*
	Golden Eagle	*Aquila chrysaetos*
	Great Egret	*Casmerodius albus*
	Green Heron	*Butorides striatus*
	Glaucous-winged Gull hybrid	*Larus sp.*
	King Eider	*Somateria spectabilis*
	Knot Spp.	
	Laughing Gull	*Larus atricilla*
	Merlin	*Falco columbarius*
	Muscovy Duck	*Cairina moschata*
	Mute Swan	*Cygnus olor*
	Northwestern Crow	*Corvus caurinus*
	Northern Goshawk	*Accipiter gentiles*

Group	Species	Scientific Name
Birds		
	Northern Harrier	*Circus cyaneus*
	Northern Saw-whet Owl	*Aegolius acadicus*
	Osprey	*Pandion haliaetus*
	Pacific Golden Plover	*Pluvialis fulva*
	Pallas's Bunting	*Emberiza pallasi*
	Peregrine Falcon	*Falco peregrinus*
	Raptor Spp.	
	Red-necked Stint	*Calidris ruficollis*
	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
	Rough-legged Hawk	*Buteo lagopus*
	Ruddy Turnstone	*Arenaria interpres*
	Sandhill Crane	*Grus canadensis*
	Short-eared Owl	*Asio flammues*
	Snowy Owl	*Nyctea scandiaca*
	Sora	*Porzana carolina*
	Sharp-shinned Hawk	*Accipiter striatus*
	Turkey Vulture	*Cathartes aura*
	Varied Thrush	*Ixoreus naevius*
	Virginia Rail	*Rallus limicola*
	White-winged Tern	*Chlidonias leucopterus*
	Wilson's Snipe	*Gallinago delicata*
	Yellow-billed Loon	*Gavia adamsii*
	Yellow-rumped Warbler	*Dendroica coronata*
Bird Nests		
	Bald Eagle Nest	
	Pelagic Cormorant Nest	
Mammals		
	Black Bear	*Ursus americanus*
	Black-tailed Deer	*Odocoileus hemionus*
	Dall's Porpoise	*Phocoenoides dalli*
	Deer Spp.	
	Dolphin Spp.	
	Gray Whale	*Eschrichtius robustus*
	Grizzly Bear	*Ursos arctos*
	Harbour Seal	*Phoca vitulina*
	Killer Whale	*Orcinus orca*
	Porpoise Spp.	
	River Otter	*Lontra canadensis*
	Sea Lion Spp.	
	Sea Otter	*Enhydra lutris*
	Seal Spp.	
	Stellar's Sea Lion	*Eumetopias jubatus*
Miscellaneous		
	Unidentified Spp.	

Appendix 5: Marine Bird Area of Interest Metadata

The following is the metadata report that accompanies the MBAOI database. The metadata contains geospatial information regarding how the database is used within a GIS software program.

Report Date: January 3rd, 2007

Metadata Data Set Name:

Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database

(Please note - the MBAOI database and hence this metadata, are works in progress and as such are subject to change without notice)

1. **Identification Information**

1.1 Citation: ***Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database***. Unpublished digital datafiles. Pacific Wildlife Research Centre, Canadian Wildlife Service, Environment Canada

Originator: Canadian Wildlife Service, Environment Canada

1.2 Description

1.2.1 Abstract:

A Marine Bird Area of Interest (MBAOI) is a marine area which meets one of the following conditions: has large numbers of birds exceeding specific thresholds; is a breeding colony; contains important nearshore habitat features; or, has high offshore bird species diversity. The underlying reason for the creation of the MBAOI database was to have available a comprehensive database that would allow the Canadian Wildlife Service (CWS) to provide land and marine planners with information regarding areas of concern to them, as well as aid in the dissemination of information during emergency situations. Since its conception, there has been a rapidly expanding list of applications for a database of this nature. A database identifying areas of interest will be key in the determination of potential conflicts between birds and such activities as oil and gas exploration and extraction, aquaculture and mariculture operations, wind turbines, forest practices, and urban development. In addition, the interpreted products from MBAOI data set could be made available to the Canadian public in keeping with the Government of Canada's objective to promote greater access to information and improvements in conservation planning.

1.2.2 Purpose:

To have available a comprehensive database that would allow the Canadian Wildlife Service to provide land and marine planners with information regarding areas of concern to them, as well as aid in the dissemination of information during emergency situations.

1.2.3 Supplemental Information:

Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database is the data-substantiated version of the *Areas of Interest for Migratory Birds in British Columbia, 1994* and is the result of 10 years of reconciling, digitizing and georeferencing major, geographically wide-ranging data sets, in addition to smaller scale more site-specific data sets, as well as analyzing the data in a meaningful and scientifically-defensible manner. The main purpose was to substantiate these notional areas with actual data, as well as to identify new areas of interest to migratory birds and species at risk. For instructions on how and when to use this database please see the ***Canadian Wildlife Service's British Columbia Marine Bird Area of Interest Database*** technical report.

IMPORTANT NOTE:

This is a **work in progress** - the size, shape, and location of these polygons are subject to change. These areas represent confirmed or inferred importance to one or many migratory bird species as mandated under the *Migratory Birds Convention Act*. The sources used in the identification of these areas are limited to Canadian Wildlife Service Technical Reports and Occasional Papers, unpublished field notes, survey notes, datasets, and personal knowledge of individual researchers associated with Canadian Wildlife Service. The areas identified represent Canadian Wildlife Service knowledge, as of 2007, of important migratory bird areas. Areas outside of our polygons cannot be construed to have no value to migratory birds. They would require more surveys to verify their values. There may be other data available from other organizations that are not represented here.

1.3 Time Period Of Content

Beginning Date: ~1960

Ending Date: 2005

Currentness Reference: **2005**

1.4 Status

Progress:

in work

Maintenance and Update Frequency:

regular

1.5 Spatial Domain

Description of Geographic Extent:

The extent falls within British Columbia's marine environment, including estuaries, bays, inlet, fjords, islands, near shore, inshore and offshore waters within Canada's Exclusive Economic Zone.

Bounding Coordinates

West Bounding Coordinate:

-138.78

East Bounding Coordinate:

-122.19

North Bounding Coordinate:

56.00

South Bounding Coordinate:

47.51

1.6 Keywords

1.6.1 Theme

Theme Keyword Thesaurus:

None

Theme Keyword:

interest

Theme Keyword:

migratory

Theme Keyword:

birds

Theme Keyword:

species

Theme Keyword:

habitat

Theme Keyword:

waterfowl

Theme Keyword:

seabirds

Theme Keyword:

shorebirds

Theme Keyword:

wetlands

Theme Keyword:

estuaries

Theme Keyword:

inlets

Theme Keyword:

fjords

Theme Keyword:

near shore waters

Theme Keyword:

inshore waters

Theme Keyword:

offshore waters

1.6.2 Place

Place Keyword Thesaurus:

None

Place Keyword:

British Columbia

Place Keyword:

Pacific Ocean

Place Keyword:

Strait of Georgia

Place Keyword:

Queen Charlotte Islands

Place Keyword:

Vancouver Island

Place Keyword:

Dixon Entrance

Place Keyword:

Hecate Strait

Place Keyword:

Queen Charlotte Sound

Place Keyword:

Queen Charlotte Strait

1.6.3 Temporal

Temporal Keyword Thesaurus:

None

Temporal Keyword:

not applicable

1.6.4 Taxonomy

Taxonomic Keywords:

Common Name	Latin Name
American Coot	*Fulica americana*
American Wigeon	*Anas americana*
Ancient Murrelet	*Synthliboramphus antiquus*
Arctic Loon	*Gavia arctica*
Bald Eagle	*Haliaeetus leucocephalus*
Barrow's Goldeneye	*Bucephala islandica*
Black-bellied Plover	*Pluvialis squatarola*
Black-footed Albatross	*Phoebastria nigripes*
Black-legged Kittiwake	*Rissa tridactyla*
Black Oystercatcher	*Haematopus bachmani*
Black Scoter	*Melanitta nigra*
Black Turnstone	*Arenaria melanocephala*
Brandt's Cormorant	*Phalacrocorax penicillatus*
Brant	*Branta bernicla*
Bufflehead	*Bucephala albeola*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Cassin's Auklet	*Ptychoramphus aleuticus*
Common Goldeneye	*Bucephala clangula*
Common Loon	*Gavia immer*
Common Merganser	*Mergus merganser*
Common Murre	*Uria aalge*
Common Tern	*Sterna hirundo*
Double-crested Cormorant	*Phalacrocorax auritus*
Dunlin	*Calidris alpina*
Eared Grebe	*Podiceps nigricollis*
Franklin's Gull	*Larus pipixcan*
Fork-tailed Storm-Petrel	*Oceanodroma furcata*
Gadwall	*Anas strepera*
Glaucous Gull	*Larus hyperboreus*
Glaucous-winged Gull	*Larus glaucescens*
Great Blue Heron	*Ardea herodias*
Greater Scaup	*Aythya marila*
Greater White-fronted Goose	*Anser albifrons*

Common Name	Latin Name
Greater Yellowlegs	*Tringa melanoleuca*
Green-winged (European) Teal	*Anas crecca*
Harlequin Duck	*Histrionicus histrionicus*
Heermann's Gull	*Larus heermanni*
Hooded Merganser	*Lophodytes cucullatus*
Horned Grebe	*Podiceps auritus*
Horned Puffin	*Fratercula corniculata*
Leach's Storm-petrel	*Oceanodroma leucorhoa*
Lesser Scaup	*Aythya affinis*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Long-tailed Duck	*Clangula hyemalis*
Mallard	*Anas platyrhnchos*
Marbled Murrelet	*Brachyramphus marmoratus*
Mew Gull	*Larus canus*
Northern Pintail	*Anas acuta*
Pacific Loon	*Gavia pacifica*
Pectoral Sandpiper	*Calidris melanotos*
Pelagic Cormorant	*Phalacrocorax pelagicus*
Pigeon Guillemot	*Cepphus columba*
Red-breasted Merganser	*Mergus serrator*
Rhinoceros Auklet	*Cerorhinca monocerata*
Ring-billed Gull	*Larus delawarensis*
Red-necked Grebe	*Podiceps grisegena*
Red-necked Phalarope	*Phalaropus lobatus*
Red-throated Loon	*Gavia stellata*
Rock Sandpiper	*Calidris ptilocnemis*
Ruddy Duck	*Oxyura jamaicensis*
Sanderling	*Calidris alba*
Short-billed Dowitcher	*Limnodromus griseus*
Snow Goose	*Chen caerulescens*
Surfbird	*Aphriza virgata*
Surf Scoter	*Melanitta perspicillata*
Thayer's Gull	*Larus thayeri*
Thick-billed Murre	*Uria lomvia*
Trumpeter Swan	*Cygnus buccinator*
Tufted Puffin	*Fratercula cirrhata*
Western Grebe	*Aechmophorus occidentalis*
Western Sandpiper	*Calidris mauri*
White-winged Scoter	*Melanitta fusca*

1.7 Access Constraints:

NA

1.8 Use Constraints:

The Canadian Wildlife Service is the exclusive or joint owner of this dataset. This dataset may be used in your organization for the exclusive use in the project noted below, but you may not use the dataset in any other project, or distribute, sell or transfer it, in whole or in part, in its current or modified form, to any other person or agency. You must receive advance written permission from the Canadian Wildlife Service, and its partners, to use this dataset for any other purpose or project. This dataset may not be displayed on the Internet, in any form, without advance written permission of the Canadian Wildlife Service and its partners.

Any intellectual property rights arising from the value-added or derived products will be vested with you provided that you hereby grant to the Minister of Environment the licensed rights to produce, publish, translate, reproduce, adapt, broadcast or use at no cost, any work subject to such intellectual property rights. The Canadian Wildlife Service, and the partners, must be acknowledged as the source(s) of the dataset in any published or printed maps, or reports.

The Canadian Wildlife Service, and the partners, is (are) not responsible for damages resulting from any omissions, deletions, or errors that may be contained in this dataset and expressly disclaims any warranty of merchantability or fitness for a particular purpose. The entire risk as to results and performance of the dataset is with you. You assume the entire risk as to the suitability of the dataset for your intended purpose. You agree to indemnify and save harmless Her Majesty against all claims, demands, losses, costs, damages, suits or other proceedings, by whomsoever made, brought or prosecuted, in any manner based upon, arising out of, related to, occasioned by or attributable to the use of the dataset.

This dataset was developed to assist with general conservation planning, and is not a substitute for site-specific surveys usually required for environmental assessment and mapping.

THE USER IS DIRECTED TO THE DISTRIBUTION LIABILITY SECTION OF THIS METADATA FILE AND TO THE LIMITED USE AGREEMENT FOR CANADIAN WILDLIFE SERVICE DIGITAL DATA FOR A COMPLETE LIST OF TERMS AND CONDITIONS ON THE AUTHORIZED USE AND DISTRIBUTION OF THIS DATASET.

Point of Contact

Contact Information:

10.2 Contact Organization Primary:

10.2.1 Contact Organization: Canadian Wildlife Service, Environment Canada

10.2.2 Contact Person:

10.3 Contact Position: Senior Habitat Conservation Coordinator

10.4 Contact Address:

10.4.1 Address Type: mailing

10.4.2 Address: 5421 Robertson Road, RR#1

10.4.3 City: Delta

10.4.4 State or Province: British Columbia

10.4.5 Postal Code: V4K 3N2

10.4.6 Country: Canada

10.5 Contact Voice Telephone: 604-940-4700

10.7 Contact Facsimile Telephone: 604-946-7022

Data Set Credit: Researchers and staff whose data contributed to the identification of areas of interest were Doug Bertram, Sean Boyd, Andre Breault, Rob Butler, Neil Dawe, Michael Dunn, Ian Goudie, Mark Hipfner, Gary Kaiser, Pam Krannitz, Moira Lemon, Rick McKelvey, Ken Morgan, Jean-Pierre Savard, and Dave Smith; or whose comments and suggestions useful were Shawna Pelech, Wendy Easton. GIS and data analysis: Krista Amey, Jason Komaromi, Kathleen Moore, Katrina Roger, Steven Shisko, Jamie Kenyon, Stephen Jollymore, Barry Alleyne, Carrie Robb, Anders Wong, and Michael Wang.

Native Data Set Environment: Arcview 3.2 GIS

Cross Reference

2. Data Quality Information

2.1 Attribute Accuracy

2.1.1 Attribute Accuracy Report:

In some cases, the only available information is outdated or limited to a single observation. Although such data are inadequate, they help to provide an initial identification of areas and an indication of where further information is required. The most accurate information is probably for locations around seabird colonies (e.g. Triangle Island). For seabird colonies, high survival and breeding philopatry of marine birds result in a predictable number of birds near the colony in the summer (Gaston and Nettleship 1981). Thus in this situation, the location of the key marine area changes very little among years, and we have high confidence in the estimated number of birds using the site.

For some of the other sites, our assessment of important habitat status is based on estimates of bird use derived from a single set of surveys. This is particularly true for long stretches of the coastline and for some of the small or remote colonies. Although many of these data were strong and sound, they are becoming dated; there is limited new information for most of these

areas in the past 15-20 years. At a few sites, the number of birds recorded in separate surveys, differed considerably. The discrepancies may be due in part to spatial or temporal changes in bird distributions or abundances. In other cases, discrepancies in estimates may be explained by differences in survey methodology. For some of the surveys used in the analysis, the purpose was to focus on all species, whereas others had target species (swans) or groups (waterfowl), in which they were interested.

It should be noted that this is a work in progress and that the size, shape, and location of these polygons are subject to change. These areas represent confirmed or inferred importance to one or many migratory marine bird species as mandated under the *Migratory Birds Convention Act*. The sources used in the identification of these areas are limited to Canadian Wildlife Service Technical Reports and Occasional Papers, unpublished field notes, survey notes, datasets, and personal knowledge of individual researchers associated with Canadian Wildlife Service. The areas identified represent Canadian Wildlife Service knowledge, as of 2007, of important migratory bird areas. Areas outside of our polygons cannot be construed to have no value to migratory birds. They would require more surveys to verify their values. There may be other data available from other organizations that have not been considered in this analysis.

One of the intended uses of the MBAOI information is as a flagging tool to alert marine planners to the existence of an important area for migratory marine birds. If any marine use changes are contemplated, it is imperative that an on-site assessment be carried out by a qualified professional to determine whether or not the proposed change will have a detrimental effect on the area.

The recognition of key marine habitat sites is a dynamic process. The importance of individual sites changes over time in response to population fluctuations and changes in habitat conditions. As a result, mapped delineations of biologically important areas do not always coincide with existing boundaries. This report represents our present understanding of the habitat needs of selected migratory bird populations.

For limitations of the individual datasets, please refer to the individual metadata reports of these datasets.

2.2 Logical Consistency Report:

For all datasets, the units used for the analysis were the provincial ecoregions. Except for the PECP Estuaries, the Herring Spawn Index and portions of the Pelagic Seabird Dataset. The Pelagic Seabird Data was divided into 2 parts. The first dealing only with bird data occurring within 3km of the shore and the second dealing with all bird data beyond 3km of the shore which did not use ecoregions for the analysis.

2.3 Completeness Report:

Not applicable

2.4 Positional Accuracy

2.4.1Horizontal Positional Accuracy

2.4.1.1 Horizontal Positional Accuracy Report:

Many of the datasets that have been analyzed for this dataset were at a scale of 1:250,000. (The polygons will be digitized to a basemap of 1:20,000.) The accuracy of the boundaries of the mapped MBAOI data is limited by the scale of the original surveys used to identify MBAOI. Therefore data may not be accurate at the scale depicted. *Enlargement of the data beyond the source scale may result in unacceptable distortion and faulty registration with other data sets.*

2.4.1.2 Vertical Positional Accuracy Report:

not applicable

2.5 Lineage

2.5.1 Source Information

- British Columbia Seabird Colony Inventory
- Pelagic Seabird Distribution off British Columbia Coast, 1982-2005
- At-Sea Surveys during 1991 Vancouver Island Marbled Murrelet Study
- Coastal Waterbird Inventory
- Bird Studies Canada Coastal Waterbird Survey
- West Vancouver Island bird surveys
- Triennial Swan Survey
- Moulting Duck Survey
- North Island Strait bird survey
- DFO herring spawn data
- Great Blue Heron Colonies data
- Seabird Surveys
- PECP Estuaries

2.5.2 Methodology

2.5.2.1 Methodology Type:

GIS

2.5.2.2 Methodology Description:

The datasets (13 in total) were combined into one Personal Geodatabase. A single table with polygons recreated more than once was created to contain all attributes of the MBAOI database. This was done because the GIS capabilities of the end users of this database were assumed to be minimal. By not creating relational tables, the attributes associated with each MBAOI can be displayed within the GIS software program by simply clicking on the polygon of interest without having to link attribute tables.

Additionally a Data Category field was added, which describes the type of dataset. The table below summarizes the Dataset Categories of all the datasets used.

Dataset Category	Dataset Name
Category #1 (Nearshore Bird Data)	
	Coastal Waterbird Inventory
	Coastal Waterbird Survey
	Moulting Seaducks
	North Island Straits Spring Waterbird Survey
	Pelagic Seabird Survey
	Seabird Ship Surveys
	Triennial Air Surveys of Trumpeter Swans
	Vancouver Island Marbled Murrelet Survey
	West Vancouver Island Waterbird Survey
Category #2 (Pelagic Bird Data)	
	Pelagic Seabird Survey
Category #3 (Colony Data)	
	Great Blue Heron Colony Locations
	Seabird Colony Inventory
Category #4 (Habitat Data)	
	Herring Spawn
	Pacific Estuary Conservation Program Identified Estuaries

In most datasets, a buffer distance was determined and applied based on the species type or survey method. After buffering the data, a 1:20,000 TRIM shoreline was used to ERASE any portions that fell on land. Thus only marine areas were used in the analysis. Threshold numbers were determined for each species by various CWS biologist. The sightings numbers were then compared to the threshold number for each transect. Only sightings numbers that exceeded the threshold were chosen as an MBAOI.

However each dataset had some unique characteristics and flaws. Thus the methodologies used for each dataset are described below. For more detailed information on each dataset please see the metadata for each individual dataset.

NEARSHORE BIRD DATA

Coastal Waterbird Inventory (SPATIALID beginning with "CWI")

All transects were attributed with the ecoregion they fell within. If a survey transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect fell within. Any transects greater than 20km were deleted. One gull sighting of 201,000 individuals was removed which was deemed erroneous. All remaining transects were buffered by 500m. An ERASE function was preformed on the resultant polygons using 1:20,000 TRIM, Thus removing all areas that fall on land. MBAOI were chosen using a threshold method.

Coastal Waterbird Survey (SPATIALID beginning with "CWS")

All transects were attributed with the ecoregion they fell within. If a survey transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect fell within. No buffer was used on the Coastal Waterbird Survey. An ERASE function was performed on the polygons using 1:20,000 TRIM shoreline, thus removing all areas that fell on land. All polygons with the same Sitecode were merged so that there were no duplications in the Sitecode field. Please note a small handful of Sitecodes do not have matching spatial data. The MBAOI were selected by comparing the maximum number of observed birds for each transect against the threshold number.

North Island Strait Spring Waterbird Survey (SPATIALID beginning with "NIS")

All transects were attributed with the ecoregion they fell within. If a survey transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect fell within. The original transects were buffered by 200m and ERASED by 1:20,000 TRIM shoreline. Using the bird numbers, the maximum number of birds of a given species within a given transect was determined. The MBAOI were chosen using a threshold method compared to the maximum number of birds.

Pelagic Seabird Survey (SPATIALID's beginning with "Pelagic3km")

The pelagic seabird data was divided into two parts. To do this, a 3km buffer of the shoreline was made. This was used to split the transects into two groups using the buffer in a CLIP function. Any transects that fell on the buffer line were split. The first part contained all seabird data within 3kms of the shoreline (Pelagic_3km) and the second all the seabird data beyond 3kms of the shoreline. In the Pelagic_3km all transects were attributed with the ecoregion they fell within. If a survey polygon or transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect or polygon fell within. Species specific threshold numbers were determined and any transects which contained species numbers greater than the threshold were chosen as MBAOI areas.

Seabird Ship Surveys (SPATIALID beginning with "sbshipsurv")

All transects were attributed with the ecoregion they fell within. If a survey transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect fell within. All transects were buffered by 200m and the resultant polygons were ERASED by 1:20,000 TRIM shoreline. The MBAOI were chosen using a threshold method.

Triennial Air Surveys of Trumpeter Swans (SPATIALID beginning with "Swan")

The original point data was buffered by 500m then it was ERASED by 1:20,000 TRIM shoreline, thus removing all areas that fell on land. The MBAOI were chosen using a threshold method.

Vancouver Island Marbled Murrelet Survey (SPATIALID beginning with "MAMU")

All transects were attributed with the ecoregion they fell within. If a survey transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect fell within. Transects were buffered by 200 m. Each species was summed within a transect for adults/juveniles and sex. For each transect, the maximum observed number of individuals on any given date was used to test again the threshold number.

West Vancouver Island Waterbird Survey (SPATIALID beginning with "WVI")

All transects were attributed with the ecoregion they fell within. If a survey transect fell within several different ecoregions, it was assigned the ecoregion in which the majority of the transect fell within. Transects deemed erroneous because the transect did not follow the set start and stop points were corrected by merging the adjacent transects, thus the lengths reflected their actual start and stop points.. New lengths were then calculated for these "erroneous" transects and they were added back to the rest of the transects. The surveys were then split into year (1999 and 2000). Also a field called Season was created. All the transects in 1999 were done in the spring and thus were assigned 'Spring' and the 2000 transects were assigned 'Winter'. Using the bird numbers, the maximum number of birds of a given species within a given transect was calculated. These maximums were tested against the threshold number.

PELAGIC BIRD DATA

Pelagic Seabird Survey (SPATIALID beginning with "Pelagic")

A 5 minute by 5 minute grid polygon was created for the entire study area. The area surveyed was all Pacific Ocean data within the Canadian Exclusive Economic Zone, but outside of three kilometres from any coastline. The grid was clipped by the boundary of the Exclusive Economic Zone on the northern and southern boundaries, but not clipped on the western boundary. The Pelagic Seabird Atlas Polygon feature class was intersected with the grids to give each transects the attributes to match the grid cell they are within spatially. Transects were often split to fit in each grid. To allow for the altered transects, a proportional ratio was found by dividing

the new transect areas to the old transect areas. The bird count numbers were multiplied by the proportional number. A Species Diversity Score was then derived for each grid cell. The Total score consisted of adding together 3 separate scores. For each score a value was found for the grid cell; then, each value was divided by the highest value of all the cells. The Species Richness Score was a count of the number of different species types within a grid cell. All unidentified species, raptors, and songbirds were removed from the score. The Species at Risk score (SAR) was a sum of the presence of particular species within each grid. Each species was given a Species at Risk value (Threatened = 1, Endangered = 2, Not threatened = 0) then all of the values were totalled in each grid. The Density Score was taken from the total density of all birds in each cell. The Densities for all birds were totalled for each transect. Next an average density was taken for each transects.

COLONY DATA

Great Blue Heron Colony Locations (SPATIALID beginning with "Heron")

All points were attributed with the ecoregion they fell within. A 3 km buffer was used on all points. With the resultant polygons, two methods were used to choose MBAOI.

1.) If the polygon intersected an estuary, it was chosen as an MBAOI.

2.) If the polygon fell within a 100m buffer of the shoreline, it was chosen as an MBAOI.

Seabird Colony Inventory (SPATIALID beginning with "sbcol")

All points were attributed with the ecoregion they fell within. All of the seabird colonies, current or historic, have been included. Points have been buffered a certain distance depending on the species breeding there (0.5, 2 and 5 km; distances decided upon consultation with M. Hipfner and M. Lemon). After assigning the species specific buffer distances (Shown in the table below), the maximum buffer distance for each point was chosen as the buffer distance. For example, if Ancient Murrelets and Black Oystercatchers were both present at one point, the buffer distance would be 5km.

Species	Buffer Size (km)
Ancient Murrelet	5
Black Oystercatcher	2
Brandt's Cormorant	2
Cassin's Auklet	5
Common Murre	5
Double-crested Cormorant	2
Fork-tailed Storm-Petrel	5
Glaucous-winged Gull	2
Horned Puffin	5

Species	Buffer Size (km)
Leach's Storm-Petrel	5
Pelagic Cormorant	2
Pigeon Guillemot	2
Rhinoceros Auklet	5
Thick-billed Murre	5
Tufted Puffin	5

The resultant polygons were clipped against TRIM. These buffers are not intended to represent the entire foraging range of the species, as some of the species are known to forage up to 100 km from the colony (e.g. Cassin's Auklet, Tranquilla *et al. 2005*) and even farther for others (storm-petrels, reference needed) but more of a common use area. When using this seabird colony data beware that some bird numbers are given in number of pairs, not individuals (see the NOTES field).

HABITAT DATA

Herring Spawn (SPATIALID beginning with "Herring_Spawn")

All points were attributed with the ecoregion they fell within. The points were then buffered by a 2 km buffer and ERASED by a 1:20,000 TRIM shoreline. MBAOI were selected by choosing points where RANK <= 526.

Pacific Estuary Conservation Program Identified Estuaries of British Columbia (SPATIALID beginning with "PECP")

The PECP Estuaries found in pecpestuary_int_subtidal_buffer_1nov04 were used. For details on how this shapefile was created please see its respective metadata found in \\Pyrdelfp\cwsshares\GIS\Projects\PECP\estuary_land_statusing\intertidal_subtidal_buffer. Please note the Fraser River, Nicomekl/Serpentine River and a small upland section of the Campbell River estuary were added to the pecpestuary_int_subtidal_buffer_1nov04. The inter-tidal and sub-tidal portions of the Fraser River and Nicomekl/Serpentine River estuaries were buffered by 1000m. Estuaries were added into the MBAOI due to their well known wildlife values and all have been deemed equally important. The PECP project itself was to capture all estuarine areas considered to be valuable bird habitat.

2.5.2.3 Methodology Citation:

Process Step see Methodology Description

Process Description:

n/a

Process Date:

n/a

Process Time:

n/a

Process Contact

2.5.3 Taxonomic Procedures

Taxonomic Procedures:

not applicable

Taxonomic Completeness:

not applicable

Vouchers

Specimen:

not applicable

Repository: not applicable

3 **Spatial Data Organization Information**

Indirect Spatial Reference:

Islands, islets, bays, inlet, rocks, points, coastline, estuaries, pockets of ocean

Direct Spatial Reference Method:

Vector

Point and Vector Object Information

SDTS Point and Vector Object Type:

Polygon

Point and Vector Object Count:

5483

4 **Spatial Reference Information**

Horizontal Coordinate System Definition

Planar

Map Projection

Map Projection Name:

Albers Conical Equal Area

Standard Parallel:

50

Standard Parallel:

58.5

Longitude Of Central Meridian:

-126

Latitude Of Projection Origin:

45

False Easting:

1000000

False Northing:

0

Planar Coordinate Information

Planar Coordinate Encoding Method:

coordinate pair

Planar Distance Units:

meters

Geodetic Model

Horizontal Datum Name:

North American Datum of 1983

Ellipsoid Name:

Geodedic Reference System 80

5 **Entity and Attribute Information**

5.1 Detailed Description

5.1.1 Entity Type

Entity Type Label

MBAOI

Attribute Type

Attribute Type Label

SpatialID

Attribute Type Definition:

Unique identifier for the MBAOI

Attribute Type Label

Data_Source

Attribute Type Definition:

Name of dataset record was derived from

Attribute Type Label

Data_Category

Attribute Type Definition:

Type of MBAOI determined from the source dataset

Attribute Type Label

Hectares

Attribute Type Definition:

Area of MBAOI polygon measured in hectares

Attribute Type Label

Ecoregion

Attribute Type Definition:

Regional location of the record based on what ecoregion the record falls within

Attribute Type Label

Season_Observed

Attribute Type Definition:

Season record was observed in or when record is most likely used by marine birds

Attribute Type Label

Species

Attribute Type Definition:

Name of species MBAOI contains

Attribute Type Label

Threshold

Attribute Type Definition:

Minimum number of birds observed within that record or the Importance Class of an estuary

6 **Distribution Information**

6.1 Distributor

Contact Information:

6.1.1 Contact Organisation Primary:

Contact Organisation: Canadian Wildlife Service, Environment Canada

Contact Person: Kathleen Moore

6.1.2 Contact Position: Ecosystem Conservation Coordinator

6.1.3 Contact Address:

10.4.1 Address Type: mailing

10.4.2 Address: 5421 Robertson Road, RR#1

10.4.3 City: Delta

10.4.4 State or Province: British Columbia

10.4.5 Postal Code: V4K 3N2

10.4.6 Country: Canada

6.1.4 Contact Voice Telephone: 604-940-4660

6.2 Contact Facsimile Telephone: 604-946-7022

6.3 Distribution Liability

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This dataset was developed to assist with general conservation planning, and is not a substitute for on-site surveys usually required for environmental assessment and mapping.
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Standard Order Process:

Digital Form

Format Name:

ArcGIS Desktop

Format Version Number:

9.1

Online Option

Computer Contact Information

Network Address

Network Resource Name:

\\Pyrdelgis\gisdb\gisdb.EC.AreasOfInterestCWS

Metadata Reference Information

Metadata Date:

October 5, 2004

Metadata Review Date:

January 3, 2007

Metadata Contact:

Contact Information:

10.2 Contact Organisation Primary:

10.2.1 Contact Organisation: Canadian Wildlife Service, Environment Canada

10.2.2 Contact Person: Kathleen Moore

10.3 Contact Position: Ecosystem Conservation Coordinator

10.4 Contact Address:

10.4.1 Address Type: mailing

10.4.2 Address: 5421 Robertson Road, RR#1

10.4.3 City: Delta

10.4.4 State or Province: British Columbia

10.4.5 Postal Code: V4K 3N2

10.4.6 Country: Canada

10.5 Contact Voice Telephone: 604-940-4660

10.7 Contact Facsimile Telephone: 604-946-7022

Metadata Standard Name:

NBII Content Standard for National Biological Information Infrastructure Metadata

Metadata Access Constraints:

none

Metadata Use Constraints:

none

Appendix 6: Seasonal Coverage of the Marine Bird Area of Interest Datasets

The following two tables display the seasonal coverage and the species observed within each season for datasets in the Nearshore Bird Data category of the MBAOI analysis. Seasonal use has been characterized by the following delineations of seasons: spring (Sp) March-May, summer (Su) June-August, fall (Fa) September-November, and winter (Wi) December-February. Seasons that are grayed out for a dataset indicate no data was collected in this time period. Species are listed alphabetically. The first table contains the Coastal Waterbird Inventory, the Coastal Waterbird Survey, the Moulting Seaducks, the North Island Straits Spring Waterbird Survey, and the Pelagic Seabird Survey datasets while the second table contains the Seabird Ship Survey, the Triennial Air Surveys of Trumpeter Swans, the Vancouver Island Marbled Murrelet Survey, and the West Vancouver Island Waterbird Survey datasets.

	Dataset																			
	Coastal Waterbird Inventory				Coastal Waterbird Survey				Moulting Seaducks				North Island Straits Spring Waterbird Survey				Pelagic Seabird Survey			
Bird Species	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**
American Coot	X		X	X	X		X	X												
American Wigeon	X		X	X	X	X	X	X					X							
Ancient Murrelet	X	X	X	X	X		X	X									X	X	X	X
Arctic Loon	X		X	X																
Baird's Sandpiper							X													
Bald Eagle	X	X	X	X	X	X	X	X					X							
Barrow's Goldeneye	X		X	X	X		X	X					X							
Black Oystercatcher	X	X	X	X	X	X	X	X					X				X	X		
Black Scoter	X	X	X	X	X	X	X	X		X			X							
Black Turnstone	X		X	X	X	X	X	X					X							
Black-bellied Plover	X				X	X	X	X												
Black-footed Albatross							X											X	X	
Black-headed Gull							X													
Black-legged Kittiwake	X	X			X		X	X									X	X	X	X
Blue-winged Teal			X		X	X	X													

Bird Species	Dataset																			
	Coastal Waterbird Inventory				Coastal Waterbird Survey				Moulting Seaducks				North Island Straits Spring Waterbird Survey				Pelagic Seabird Survey			
	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi
Bonaparte's Gull	X		X	X	X	X	X	X									X	X	X	
Brandt's Cormorant	X		X	X	X	X	X	X					X					X	X	
Brant	X	X	X	X	X		X	X									X	X		
Bufflehead	X		X	X	X	X	X	X					X							
California Gull		X			X	X	X	X									X	X	X	
Canada Goose	X	X	X	X	X	X	X	X		X			X				X	X		
Canvasback	X			X	X		X	X												
Caspian Tern					X	X	X											X		
Cassin's Auklet	X					X	X	X									X	X		
Cinnamon Teal					X															
Common Goldeneye	X		X	X	X	X	X	X					X							
Common Loon	X	X	X	X	X	X	X	X					X				X	X		
Common Merganser	X	X	X	X	X	X	X	X					X							
Common Murre	X	X	X	X	X	X	X	X		X			X				X	X	X	X
Common Tern					X	X	X												X	
Double-crested Cormorant	X		X	X	X	X	X	X					X				X	X	X	
Dunlin	X			X	X	X	X	X												
Eared Grebe	X		X	X	X		X	X												
Eurasian Wigeon				X	X		X	X												
Fork-tailed Storm-petrel																	X	X	X	
Franklin's Gull					X		X	X												
Gadwall				X	X	X	X	X												
Glaucous Gull					X			X												
Glaucous-winged Gull	X	X	X	X	X	X	X	X					X				X	X	X	X
Great Blue Heron	X	X	X	X	X	X	X	X		X			X							
Greater Scaup	X	X	X	X	X	X	X	X												
Greater White-fronted Goose	X		X	X	X	X	X	X												
Greater Yellowlegs					X	X	X	X												

	Dataset																			
	Coastal Waterbird Inventory				Coastal Waterbird Survey				Moulting Seaducks				North Island Straits Spring Waterbird Survey				Pelagic Seabird Survey			
Bird Species	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**
Green-winged Teal	X	X	X	X	X	X	X	X					X							
Harlequin Duck	X	X	X	X	X	X	X	X					X				X	X		
Heermann's Gull					X	X	X	X												
Herring Gull	X		X	X	X	X	X	X										X	X	X
Hooded Merganser	X	X	X	X	X	X	X	X					X							
Horned Grebe	X	X	X	X	X	X	X	X					X							
Iceland Gull					X															
Killdeer	X	X			X	X	X	X												
Leach's Storm-petrel																				
Least Sandpiper					X	X	X	X												
Lesser Scaup	X			X	X		X	X												
Lesser Yellowlegs		X			X	X	X	X												
Little Gull							X													
Long-billed Curlew					X		X	X												
Long-billed Dowitcher					X	X	X	X												
Long-tailed Duck	X	X	X	X	X	X	X	X					X							
Mallard	X	X	X	X	X	X	X	X					X							
Marbled Godwit					X		X	X												
Marbled Murrelet	X	X	X	X	X	X	X	X		X			X				X	X	X	X
Mew Gull	X	X	X	X	X	X	X	X					X				X	X	X	X
Northern Fulmar								X										X		
Northern Pintail	X	X	X	X	X	X	X	X												
Northern Shoveler	X		X	X	X		X	X												
Pacific Loon	X	X	X	X	X	X	X	X					X				X	X	X	X
Parasitic Jaeger					X		X											X	X	
Pectoral Sandpiper						X	X													
Pelagic Cormorant	X		X	X	X	X	X	X					X				X	X	X	X
Pied-billed Grebe					X	X	X	X												
Pigeon Guillemot	X	X	X	X	X	X	X	X					X				X	X	X	

Bird Species	Dataset																			
	Coastal Waterbird Inventory				Coastal Waterbird Survey				Moulting Seaducks				North Island Straits Spring Waterbird Survey				Pelagic Seabird Survey			
	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi
Pomarine Jaeger							X												X	
Red Knot					X		X													
Red Phalarope								X											X	
Redhead				X	X															
Red-breasted Merganser	X		X	X	X	X	X	X		X			X				X			
Red-necked Grebe	X	X	X	X	X	X	X	X					X						X	
Red-necked Phalarope			X				X											X	X	
Red-throated Loon	X	X	X	X	X	X	X	X									X	X	X	X
Rhinoceros Auklet	X	X	X	X	X	X	X	X		X							X	X	X	
Ring-billed Gull					X	X	X	X											X	
Ring-necked Duck	X			X	X		X	X												
Rock Sandpiper					X		X	X												
Ruddy Duck	X	X	X	X	X		X	X					X							
Sabine's Gull		X																		X
Sanderling		X			X	X	X	X												
Semipalmated Plover		X			X		X	X												
Semipalmated Sandpiper					X	X	X													
Sharp-tailed Sandpiper							X													
Short-billed Dowitcher					X	X	X	X												
Short-tailed Shearwater																			X	
Slaty-backed Gull		X			X														X	
Snow Goose	X			X	X	X	X	X												
Solitary Sandpiper					X			X												
Sooty Shearwater							X											X	X	
Spotted Sandpiper					X	X	X	X												
Stilt Sandpiper							X													
Surf Scoter	X	X	X	X	X	X	X	X		X			X				X	X	X	
Surfbird	X		X		X	X	X	X					X							
Thayer's Gull			X		X	X	X	X											X	X

	Dataset																			
	Coastal Waterbird Inventory				Coastal Waterbird Survey				Moulting Seaducks				North Island Straits Spring Waterbird Survey				Pelagic Seabird Survey			
Bird Species	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**	**Sp**	**Su**	**Fa**	**Wi**
Trumpeter Swan	X		X	X	X	X	X	X					X					X		
Tufted Puffin	X	X								X								X	X	
Tundra Swan		X			X	X	X	X												
Wandering Tattler					X		X													
Western Grebe	X	X	X	X	X	X	X	X					X						X	
Western Gull					X		X	X									X	X	X	
Western Sandpiper			X		X	X	X	X												
Whimbrel	X				X	X	X													
White-winged Scoter	X	X	X	X	X	X	X	X					X				X	X	X	
Willet								X												
Wood Duck					X	X	X	X												

Below is the second table displaying the seasonal coverage of the Seabird Ship Survey, Triennial Air Survey of Trumpeter Swans, the Vancouver Island Marbled Murrelet Survey, and the West Vancouver Island Waterbird Survey datasets.

	Dataset															
	Seabird Ship Survey				Triennial Air Surveys of Trumpeter Swans				Vancouver Island Marbled Murrelet Survey				West Vancouver Island Waterbird Survey			
Bird Species	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi
American Coot																
American Wigeon	X												X			X
Ancient Murrelet																
Arctic Loon																
Baird's Sandpiper																
Bald Eagle									X	X			X			X
Barrow's Goldeneye	X												X			X
Black Oystercatcher									X	X			X			X
Black Scoter										X			X			X
Black Turnstone										X						X
Black-bellied Plover																
Black-footed Albatross																
Black-headed Gull																
Black-legged Kittiwake										X						
Blue-winged Teal																
Bonaparte's Gull									X	X						
Brandt's Cormorant																
Brant	X									X			X			
Bufflehead									X				X			X
California Gull									X							
Canada Goose									X				X			X
Canvasback																
Caspian Tern																
Cassin's Auklet										X						
Cinnamon Teal																
Common Goldeneye	X												X			X
Common Loon	X	X							X	X			X			X

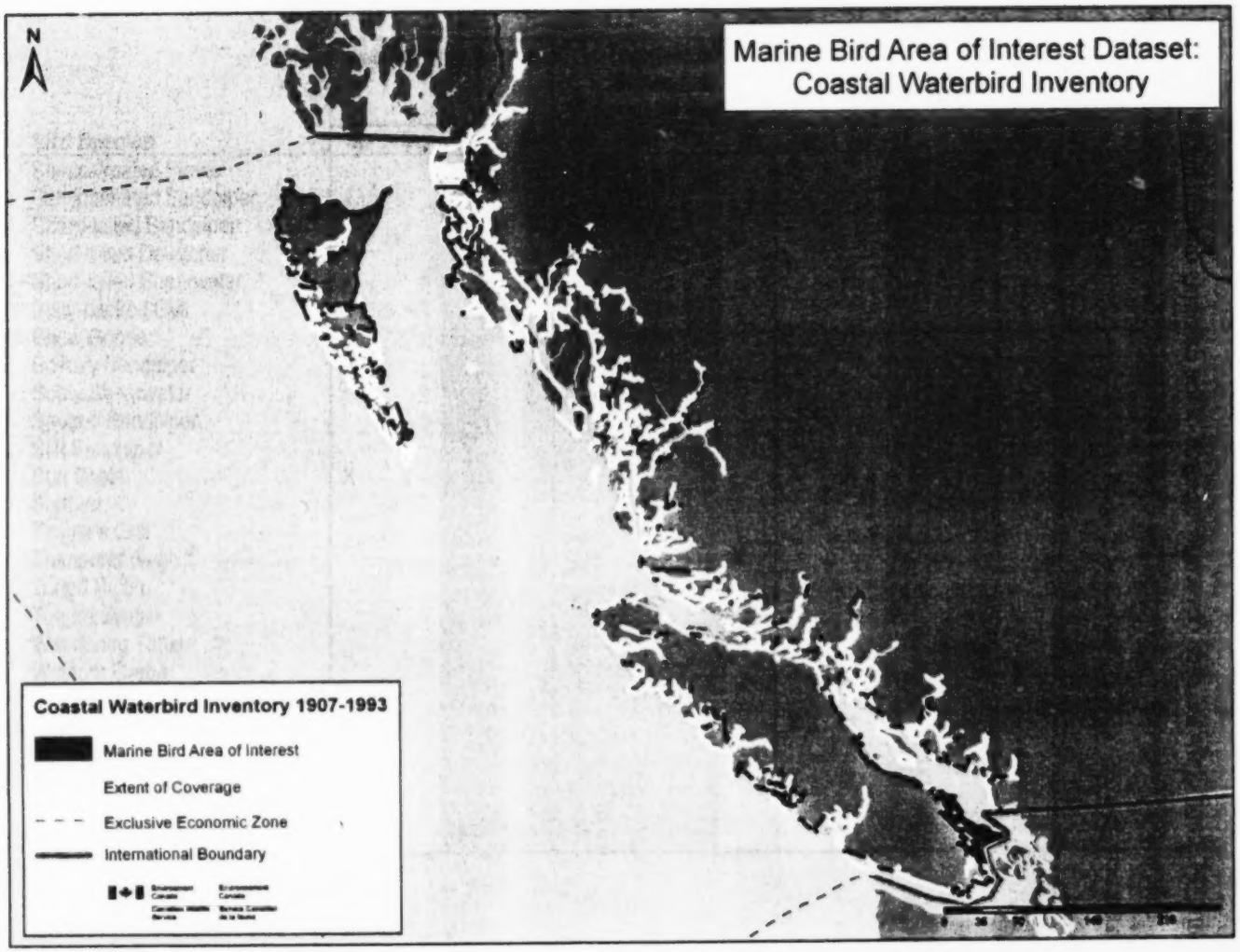
Bird Species	Dataset															
	Seabird Ship Survey				Triennial Air Surveys of Trumpeter Swans				Vancouver Island Marbled Murrelet Survey				West Vancouver Island Waterbird Survey			
	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi
Common Merganser	X	X							X	X			X			X
Common Murre	X	X							X	X			X			X
Common Tern																
Double-crested Cormorant	X									X			X			X
Dunlin									X							
Eared Grebe																
Eurasian Wigeon																
Fork-tailed Storm-petrel																
Franklin's Gull																
Gadwall																
Glaucous Gull																
Glaucous-winged Gull									X	X			X			X
Great Blue Heron									X	X			X			X
Greater Scaup	X															
Greater White-fronted Goose																
Greater Yellowlegs																
Green-winged Teal	X															X
Harlequin Duck	X								X	X			X			X
Heermann's Gull																
Herring Gull													X			X
Hooded Merganser																X
Horned Grebe													X			X
Iceland Gull																
Killdeer																
Leach's Storm-petrel										X						
Least Sandpiper																
Lesser Scaup																
Lesser Yellowlegs																
Little Gull																
Long-billed Curlew																

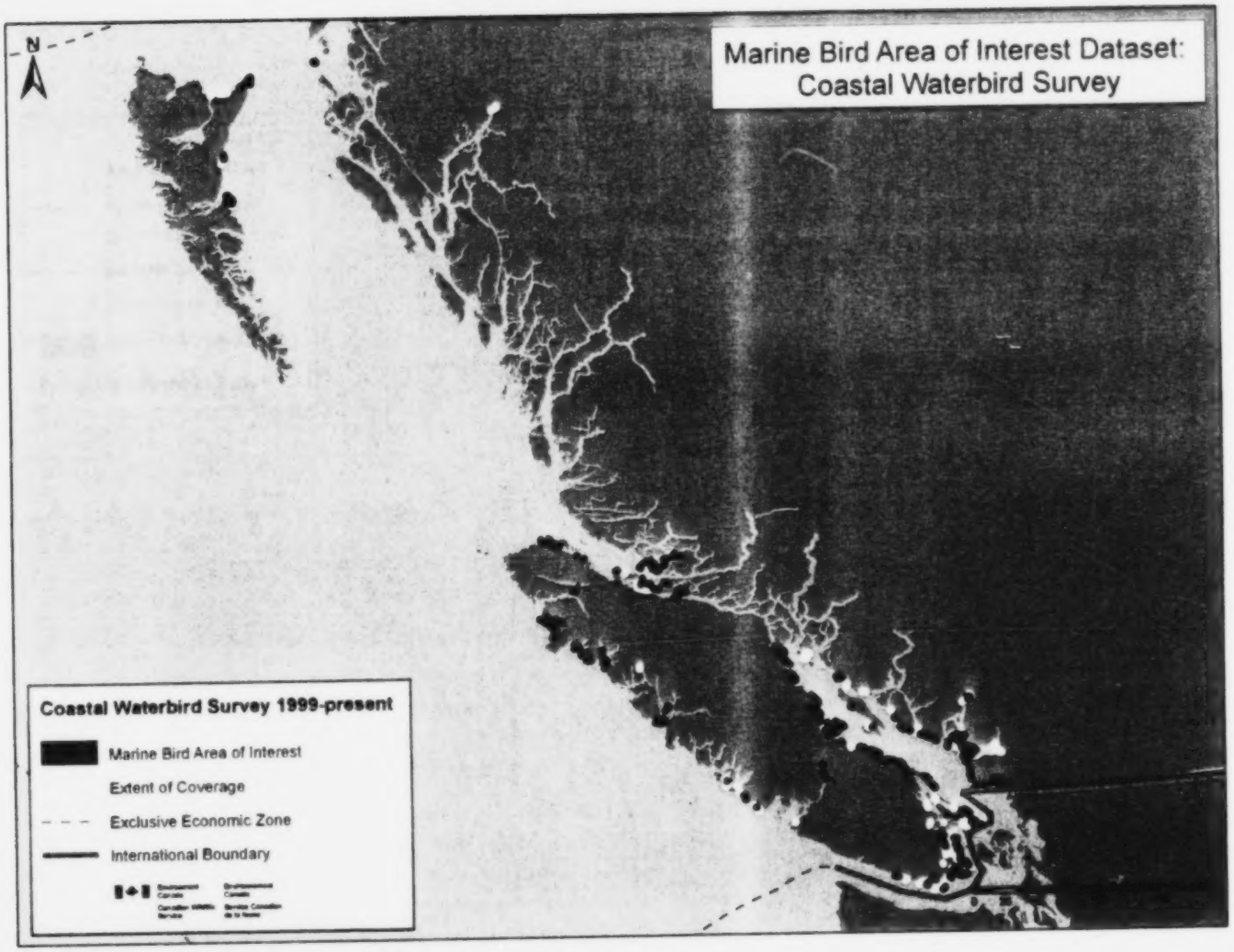
Bird Species	Dataset															
	Seabird Ship Survey				Triennial Air Surveys of Trumpeter Swans				Vancouver Island Marbled Murrelet Survey				West Vancouver Island Waterbird Survey			
	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi
Long-billed Dowitcher																
Long-tailed Duck													X			X
Mallard													X			X
Marbled Godwit																
Marbled Murrelet	X	X							X	X			X			X
Mew Gull									X	X			X			X
Northern Fulmar																
Northern Pintail																
Northern Shoveler	X															
Pacific Loon	X	X											X			X
Parasitic Jaeger																
Pectoral Sandpiper																
Pelagic Cormorant	X								X	X			X			X
Pied-billed Grebe																
Pigeon Guillemot	X	X							X	X			X			
Pomarine Jaeger																
Red Knot																
Red Phalarope																
Redhead																
Red-breasted Merganser									X				X			X
Red-necked Grebe	X												X			X
Red-necked Phalarope	X									X						
Red-throated Loon	X	X							X	X						
Rhinoceros Auklet	X	X							X	X						
Ring-billed Gull																
Ring-necked Duck																
Rock Sandpiper																
Ruddy Duck																
Sabine's Gull																
Sanderling																

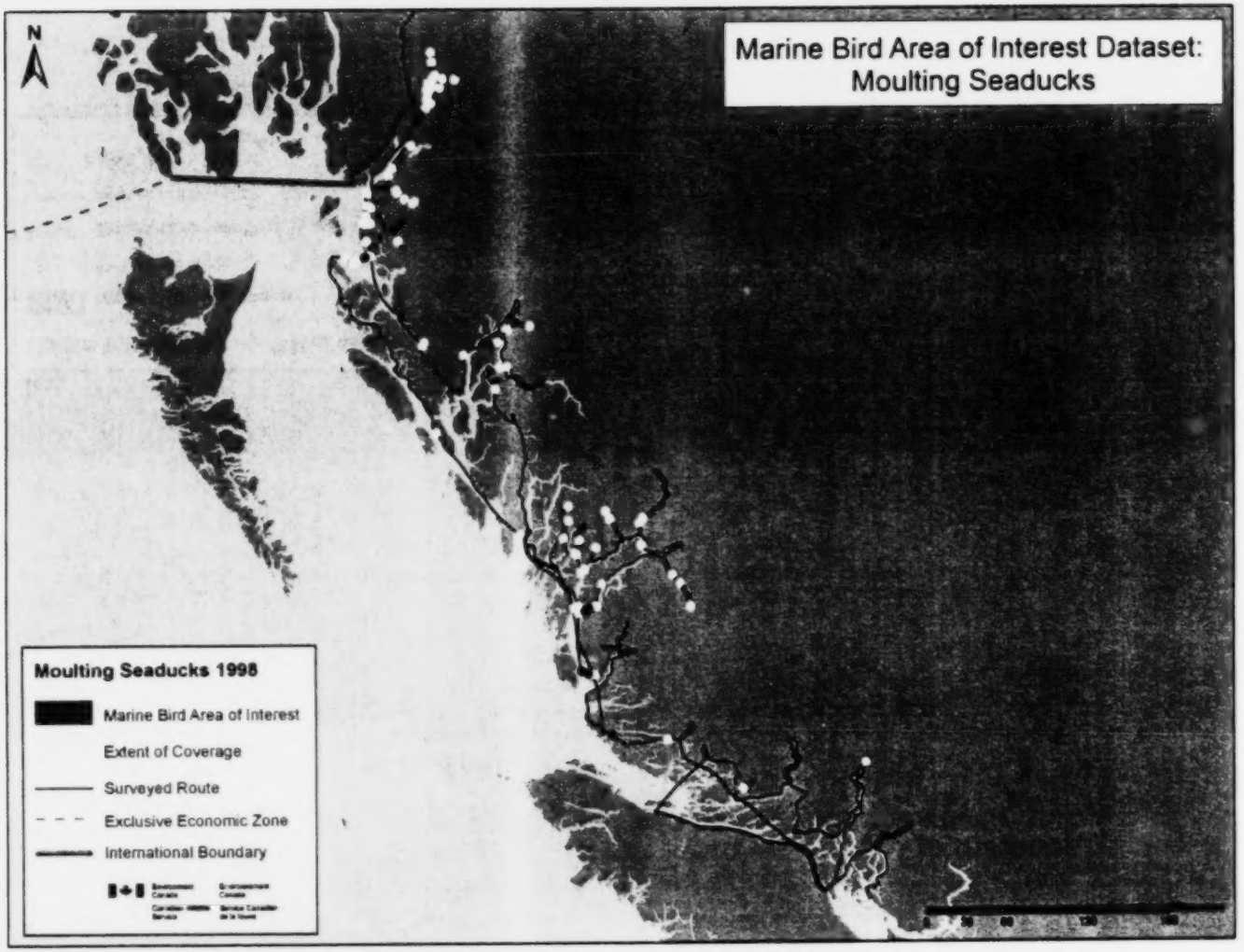
Bird Species	Dataset															
	Seabird Ship Survey				Triennial Air Surveys of Trumpeter Swans				Vancouver Island Marbled Murrelet Survey				West Vancouver Island Waterbird Survey			
	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa	Wi
Semipalmated Plover									X							
Semipalmated Sandpiper																
Sharp-tailed Sandpiper																
Short-billed Dowitcher																
Short-tailed Shearwater																
Slaty-backed Gull																
Snow Goose																
Solitary Sandpiper																
Sooty Shearwater																
Spotted Sandpiper																
Stilt Sandpiper																
Surf Scoter	X	X							X	X			X			X
Surfbird																X
Thayer's Gull																
Trumpeter Swan								X								
Tufted Puffin																
Tundra Swan																
Wandering Tattler																
Western Grebe									X				X			X
Western Gull																
Western Sandpiper									X	X						
Whimbrel										X						
White-winged Scoter	X								X	X			X			X
Willet																
Wood Duck																

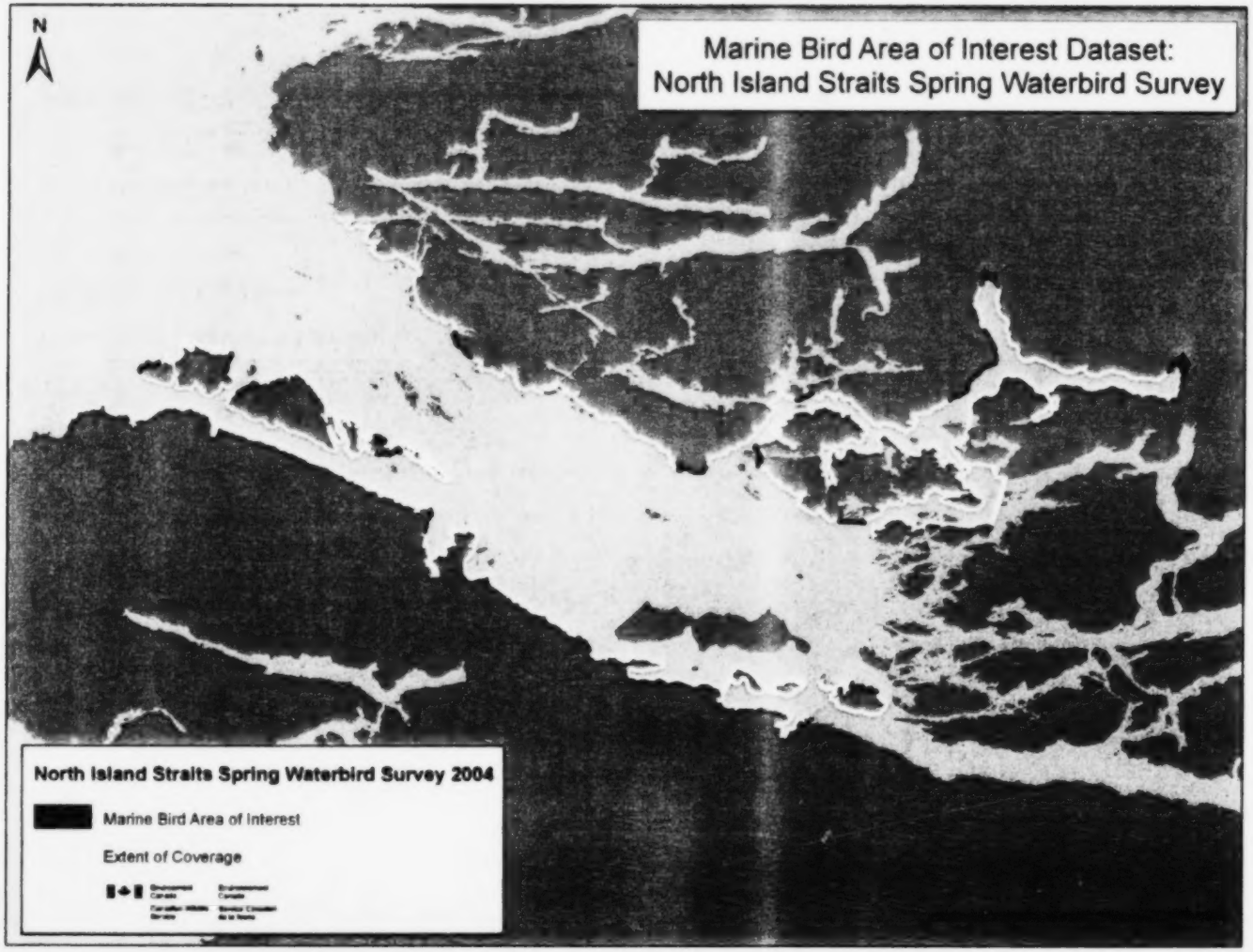
Appendix 7: Spatial Coverage of Datasets Included in the Marine Bird Area of Interest Database

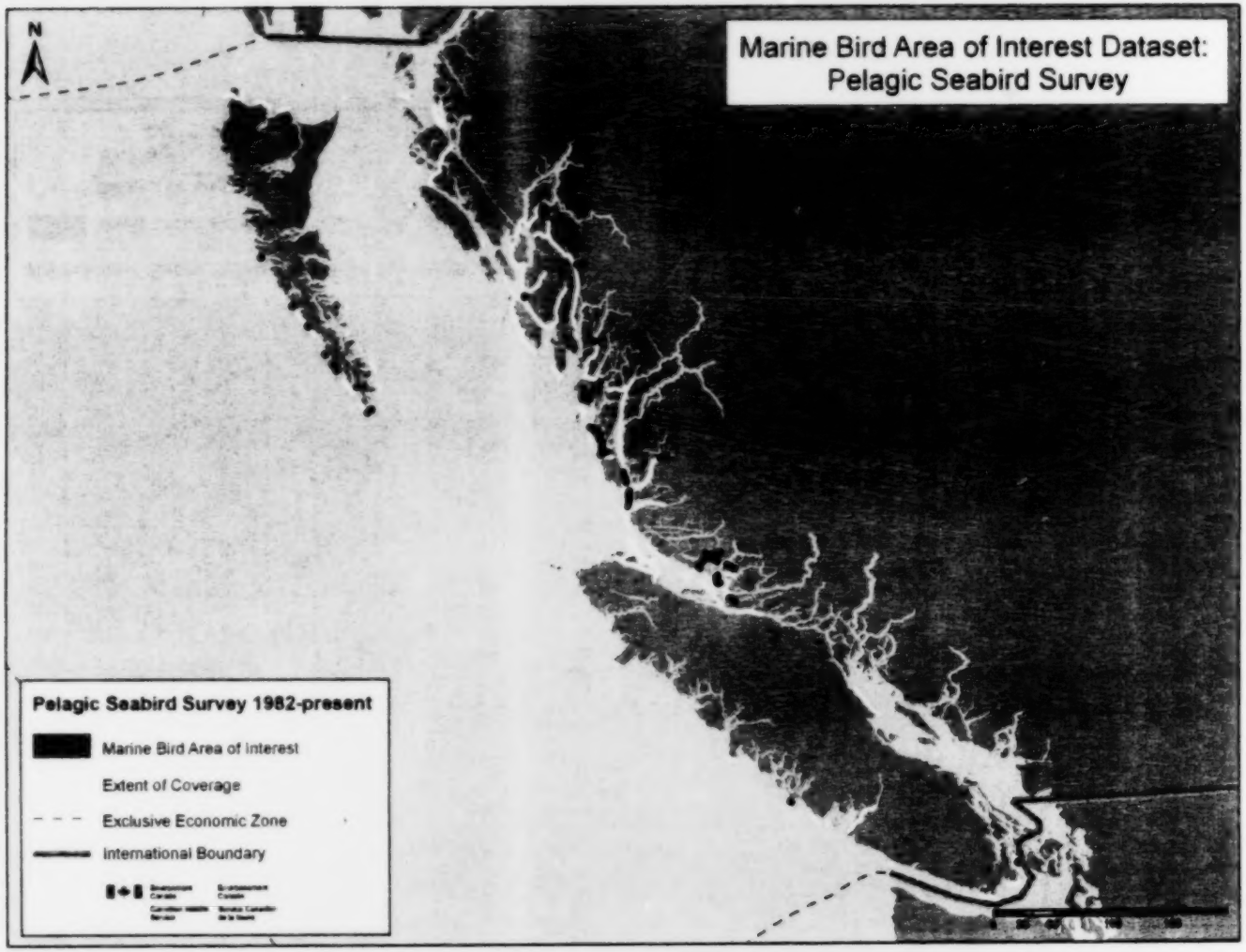
The following 14 maps show the data coverage for each of the datasets used in the MBAOI database. Yellow areas represent areas that have been surveyed. Red areas are the areas that have been selected as an MBAOI. The scale of each map is dependant upon the spatial extent of the dataset.

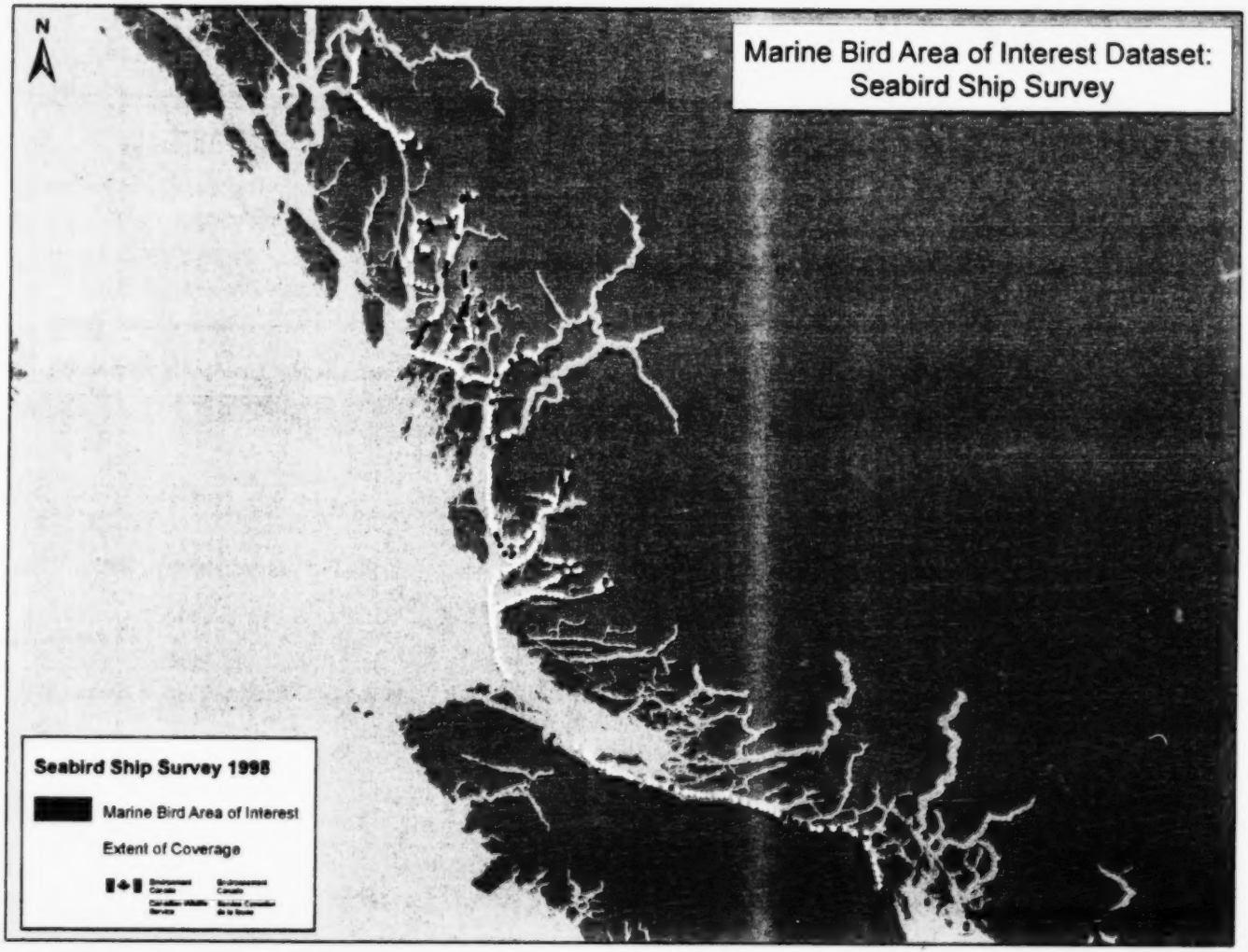

N
Marine Bird Area of Interest Dataset:
Coastal Waterbird Inventory
Coastal Waterbird Inventory 1907-1993
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary

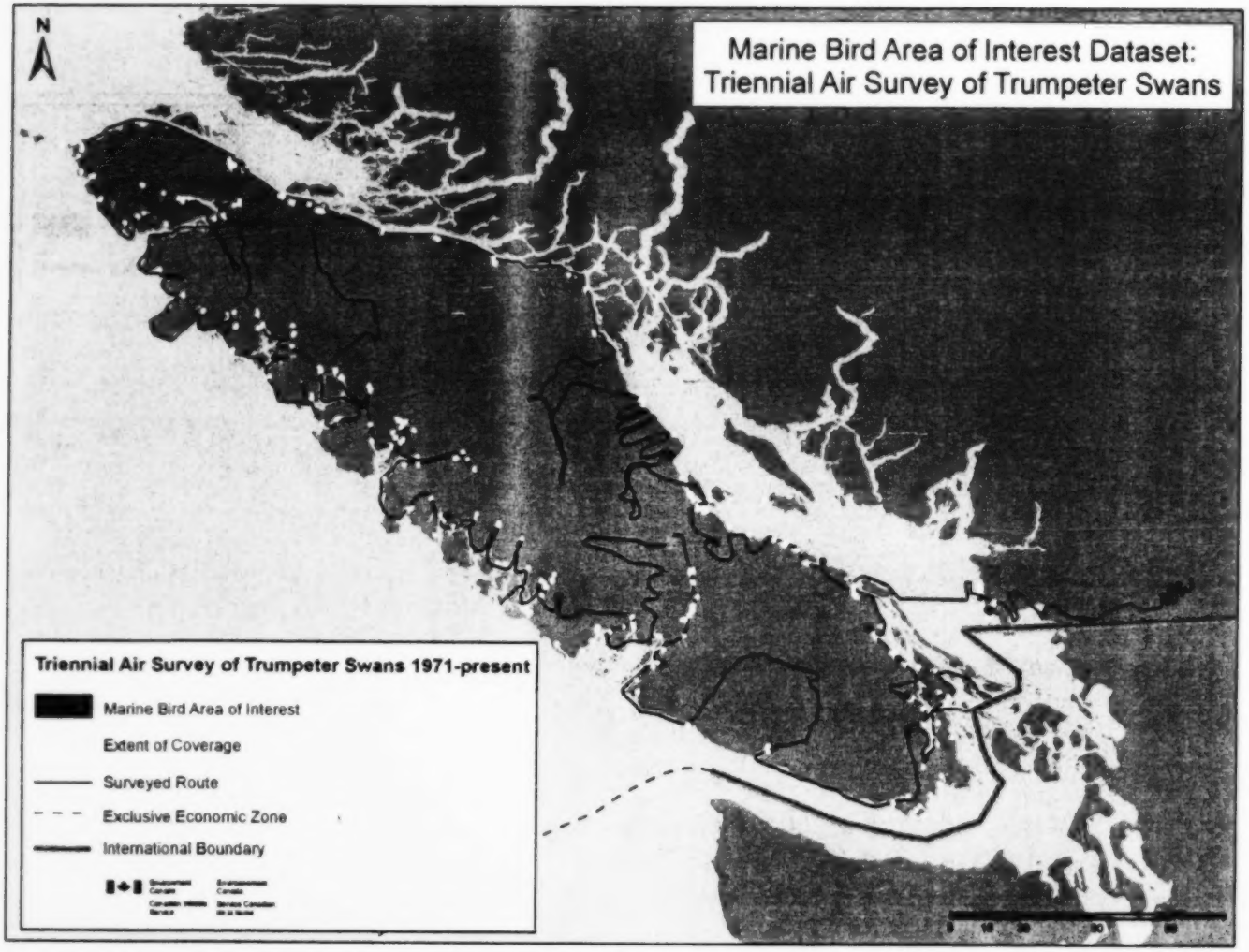

N
Marine Bird Area of Interest Dataset:
Coastal Waterbird Survey
Coastal Waterbird Survey 1999-present
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary

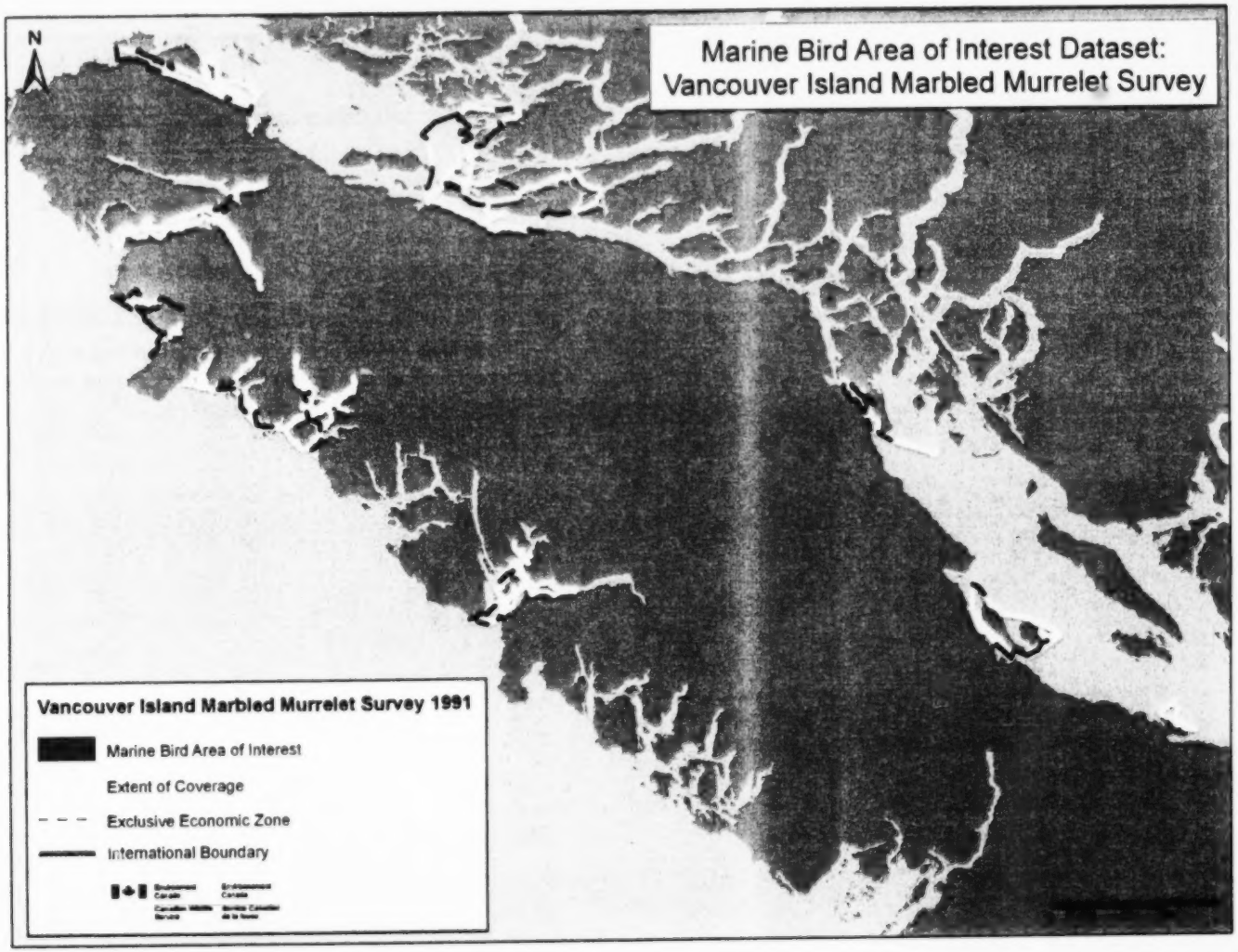

N
Marine Bird Area of Interest Dataset:
Moulting Seaducks
Moulting Seaducks 1998
Marine Bird Area of Interest
Extent of Coverage
Surveyed Route
Exclusive Economic Zone
International Boundary

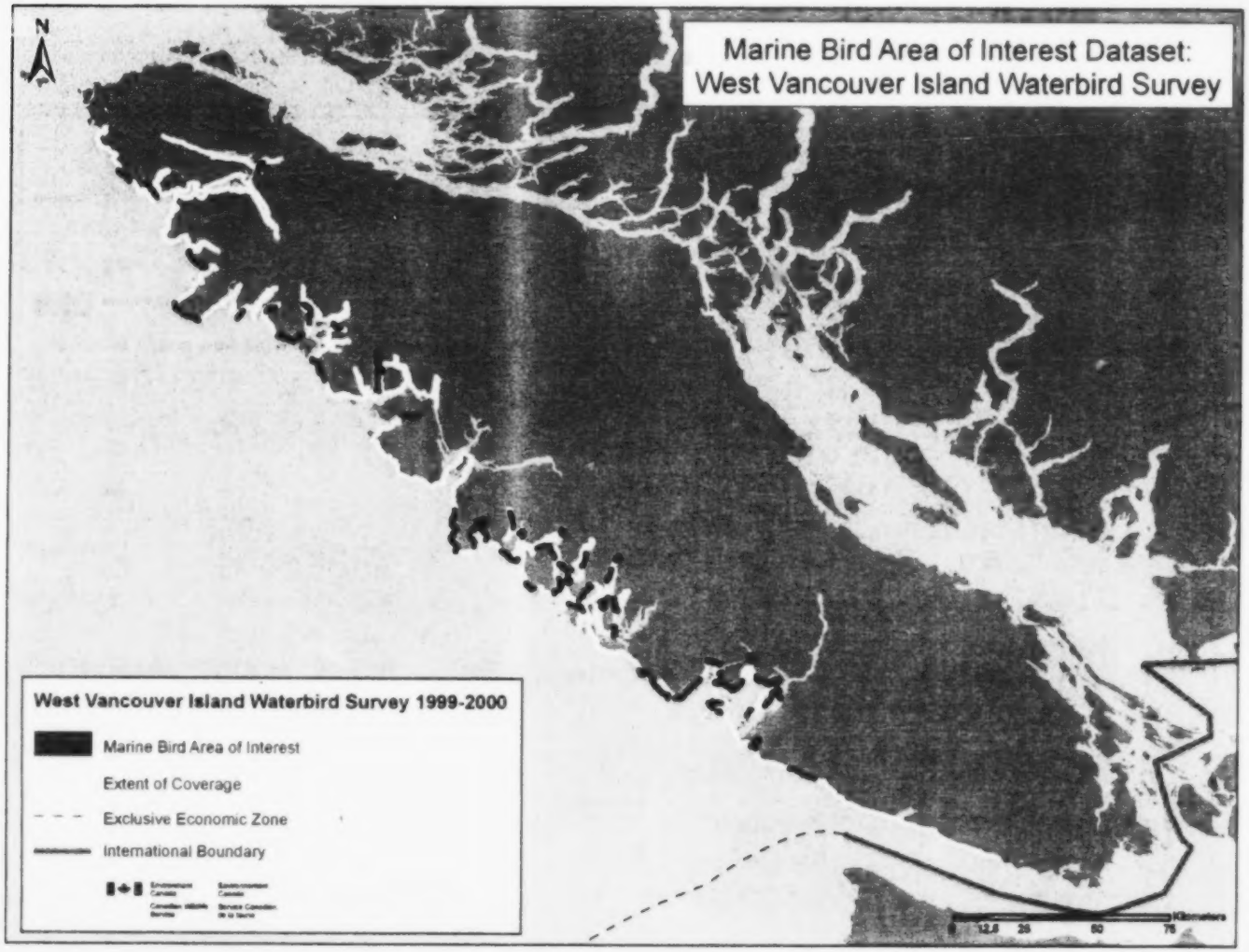

N
Marine Bird Area of Interest Dataset:
North Island Straits Spring Waterbird Survey
North Island Straits Spring Waterbird Survey 2004
Marine Bird Area of Interest
Extent of Coverage

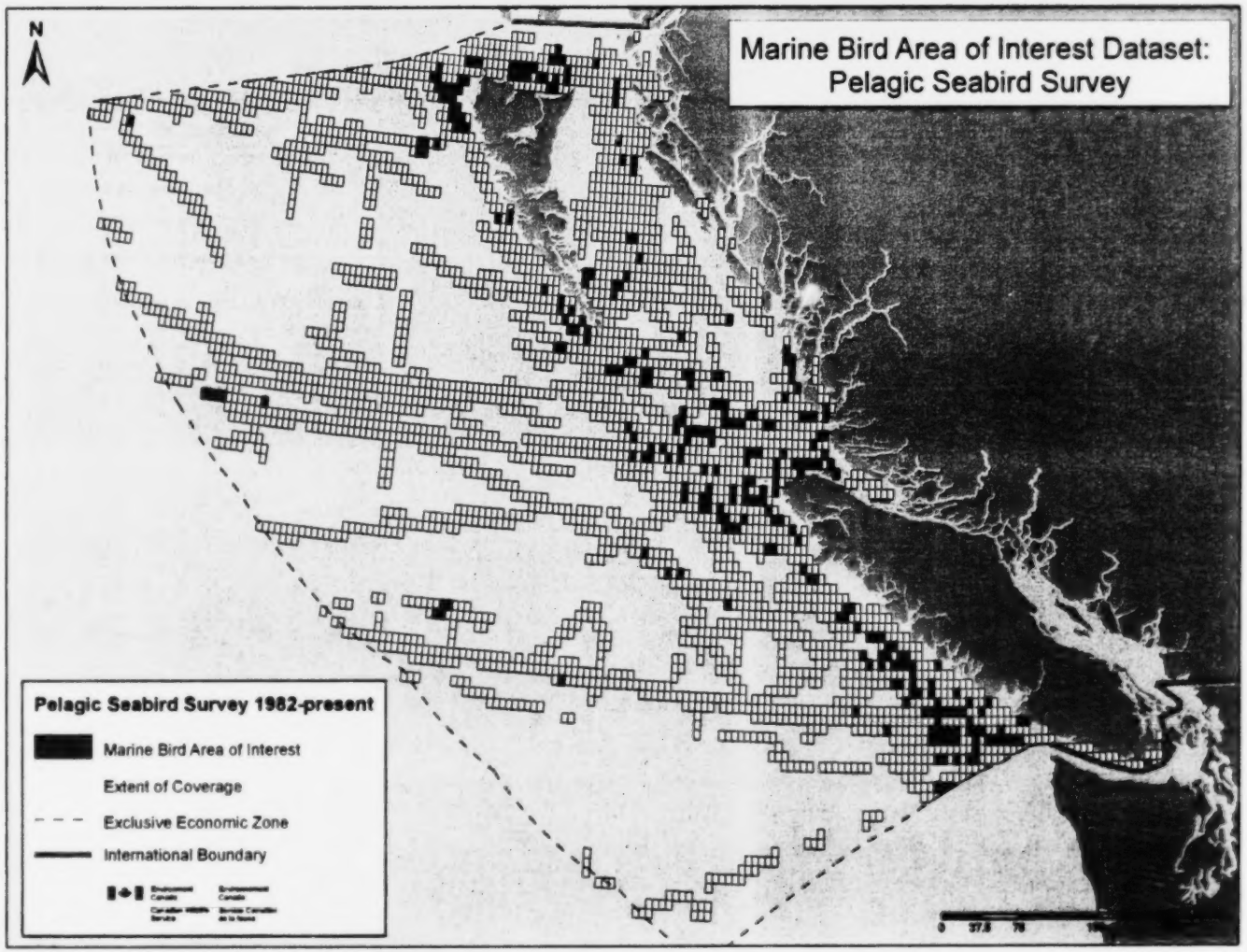

N
Marine Bird Area of Interest Dataset:
Pelagic Seabird Survey
Pelagic Seabird Survey 1982-present
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary

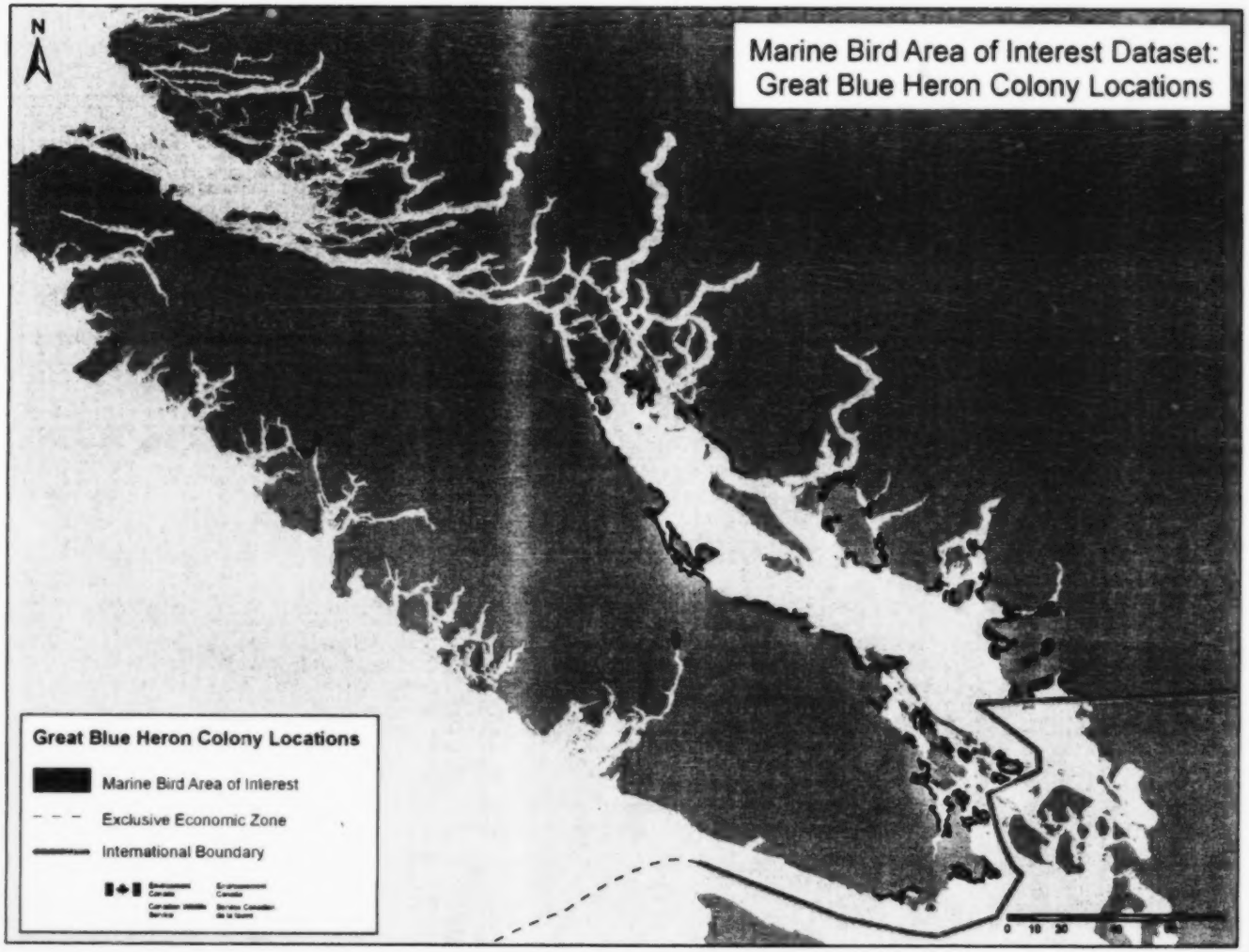

N
Marine Bird Area of Interest Dataset:
Seabird Ship Survey
Seabird Ship Survey 1998
Marine Bird Area of Interest
Extent of Coverage

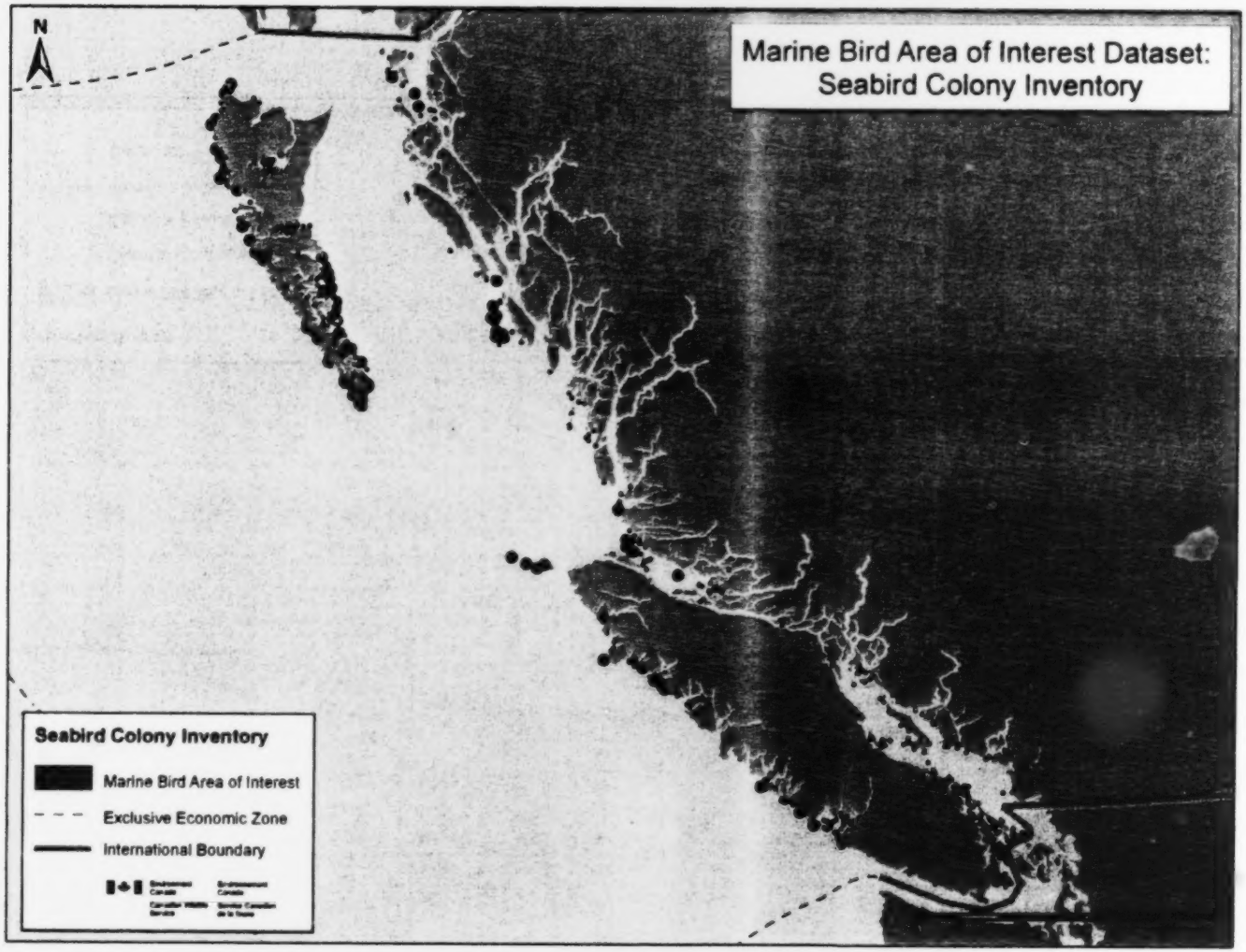

N
Marine Bird Area of Interest Dataset:
Triennial Air Survey of Trumpeter Swans
Triennial Air Survey of Trumpeter Swans 1971-present
Marine Bird Area of Interest
Extent of Coverage
Surveyed Route
Exclusive Economic Zone
International Boundary

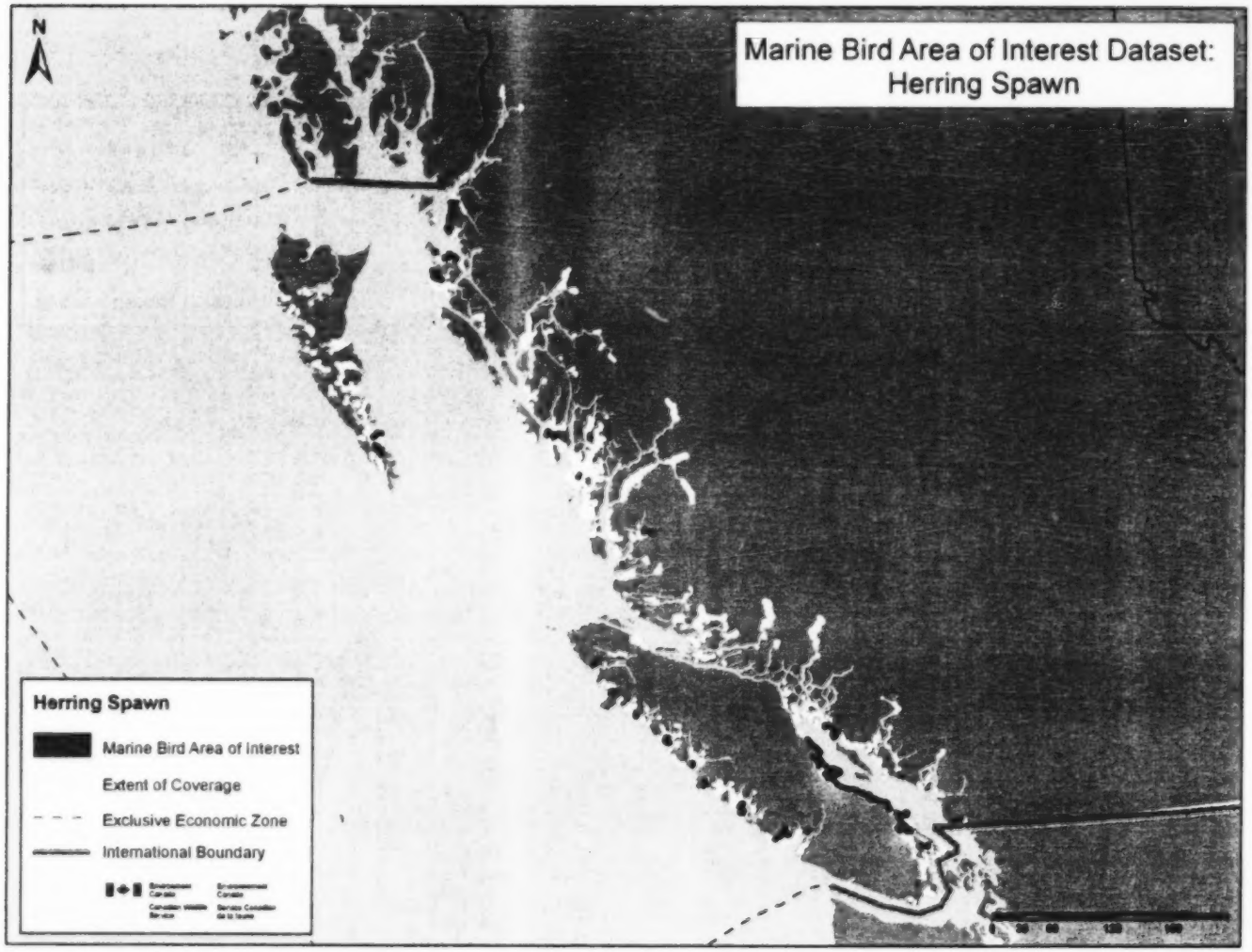

N
Marine Bird Area of Interest Dataset:
Vancouver Island Marbled Murrelet Survey
Vancouver Island Marbled Murrelet Survey 1991
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary

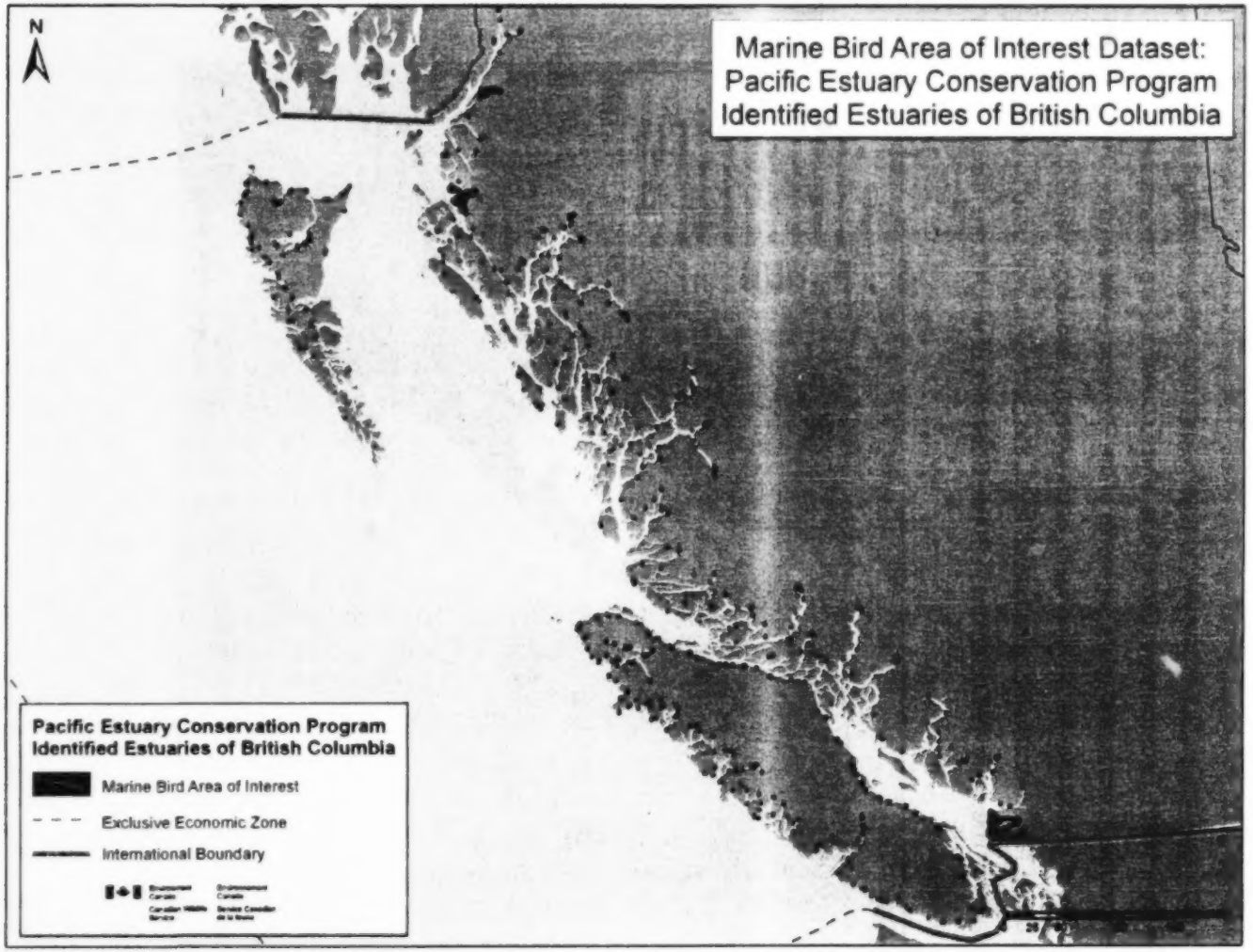

N
Marine Bird Area of Interest Dataset:
West Vancouver Island Waterbird Survey
West Vancouver Island Waterbird Survey 1999-2000
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary


N
Marine Bird Area of Interest Dataset:
Pelagic Seabird Survey
Pelagic Seabird Survey 1982-present
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary


N
Marine Bird Area of Interest Dataset:
Great Blue Heron Colony Locations
Great Blue Heron Colony Locations
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary

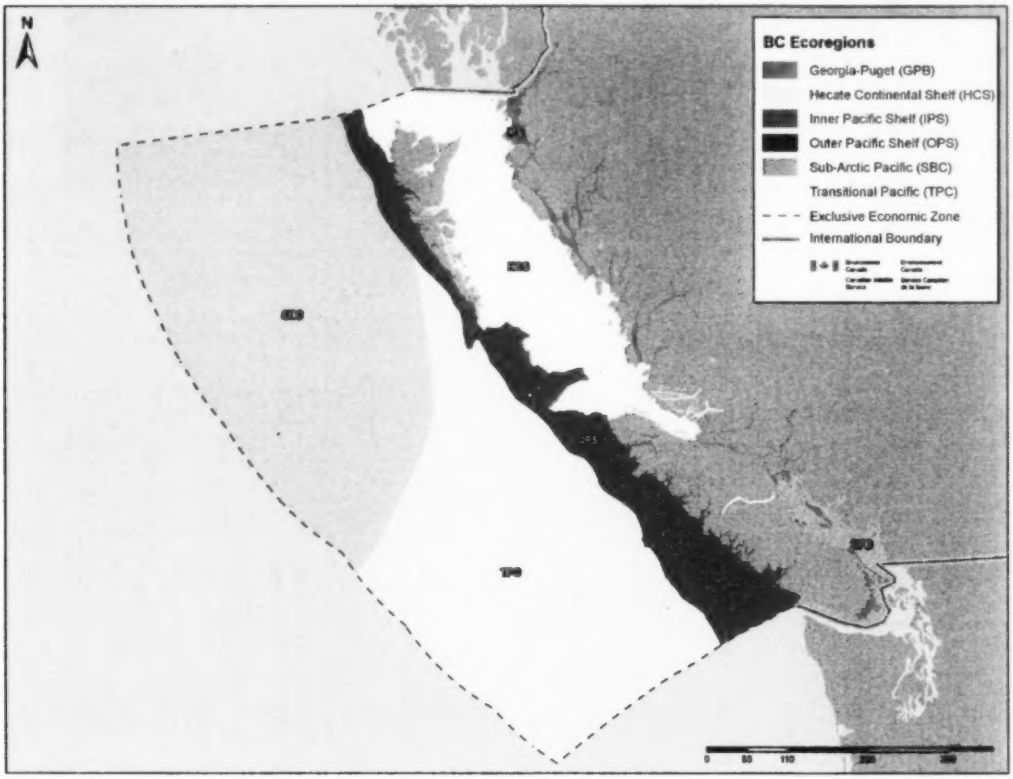

N
Marine Bird Area of Interest Dataset:
Seabird Colony Inventory
Seabird Colony Inventory
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary


N
Marine Bird Area of Interest Dataset:
Herring Spawn
Herring Spawn
Marine Bird Area of Interest
Extent of Coverage
Exclusive Economic Zone
International Boundary


N
Marine Bird Area of Interest Dataset:
Pacific Estuary Conservation Program
Identified Estuaries of British Columbia
Pacific Estuary Conservation Program
Identified Estuaries of British Columbia
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary

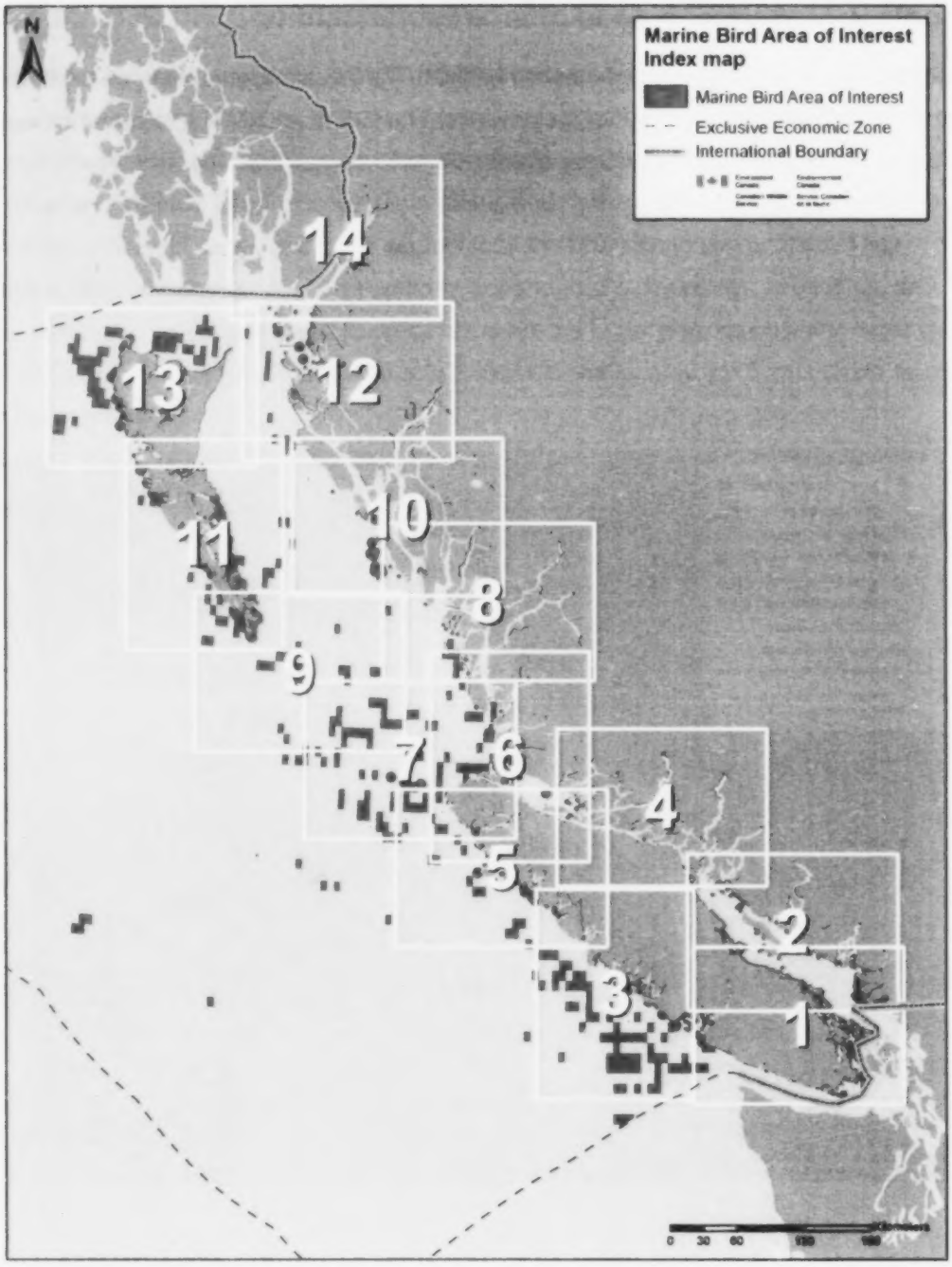
Appendix 8: Ecoregion Classification of British Columbia

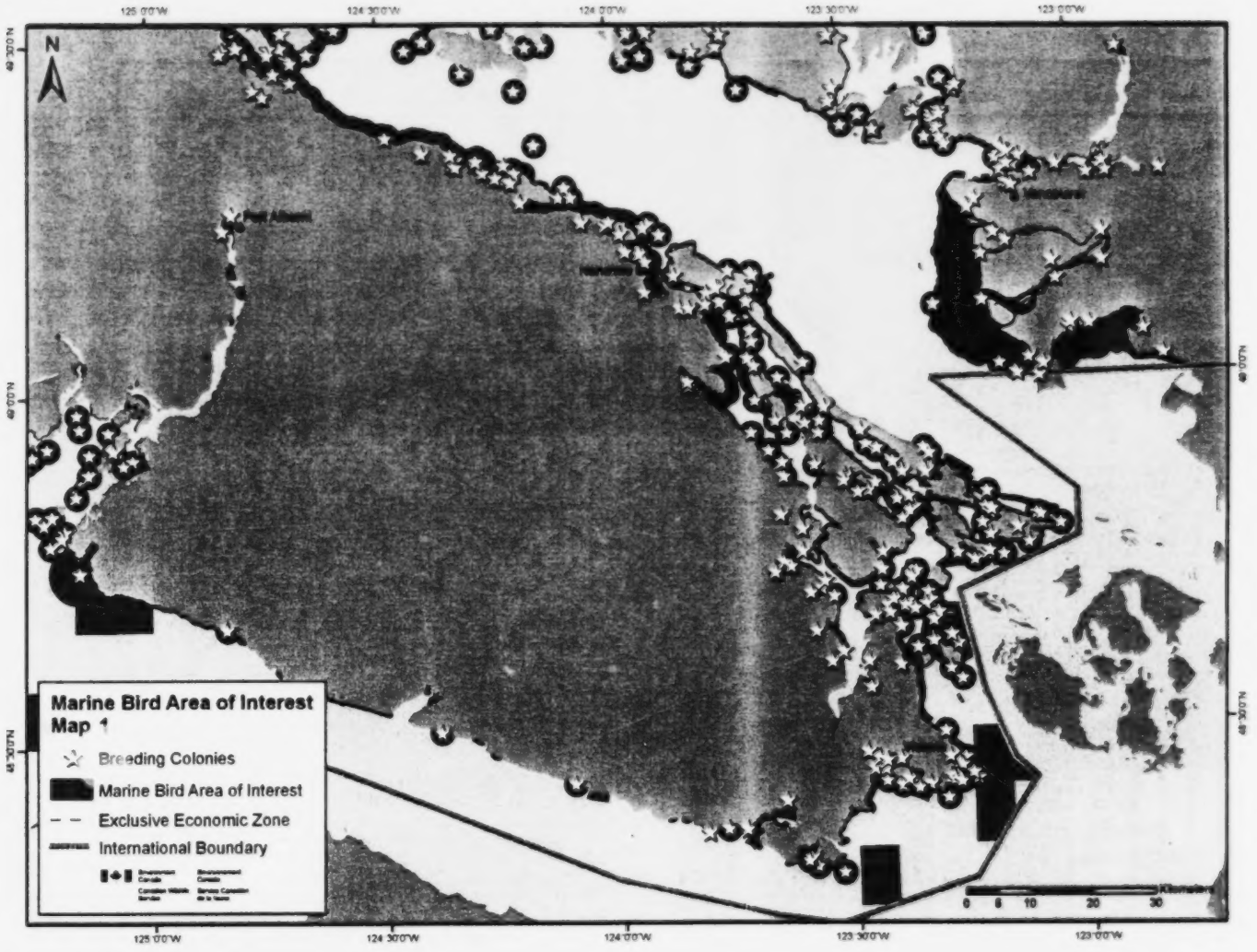
To allow for easier querying of the MBAOI database, polygons were organized according to the Ecoregion Classification System. This system was developed in 1985 to stratify British Columbia's terrestrial and marine ecosystem complexity into discrete geographical units at five levels (Demarchi 1995). Ecoprovinces, Ecoregions, and Ecosections are progressively more detailed and narrow in scope and relate segments of the Province to one another. They describe areas of similar climate, physiography, oceanography, hydrology, vegetation, and wildlife potential. The second finest classification level, the Ecoregion, was used to organize the MBAOI database. There are 48 Ecoregions in British Columbia, of which 6 are marine as shown in the figure below.

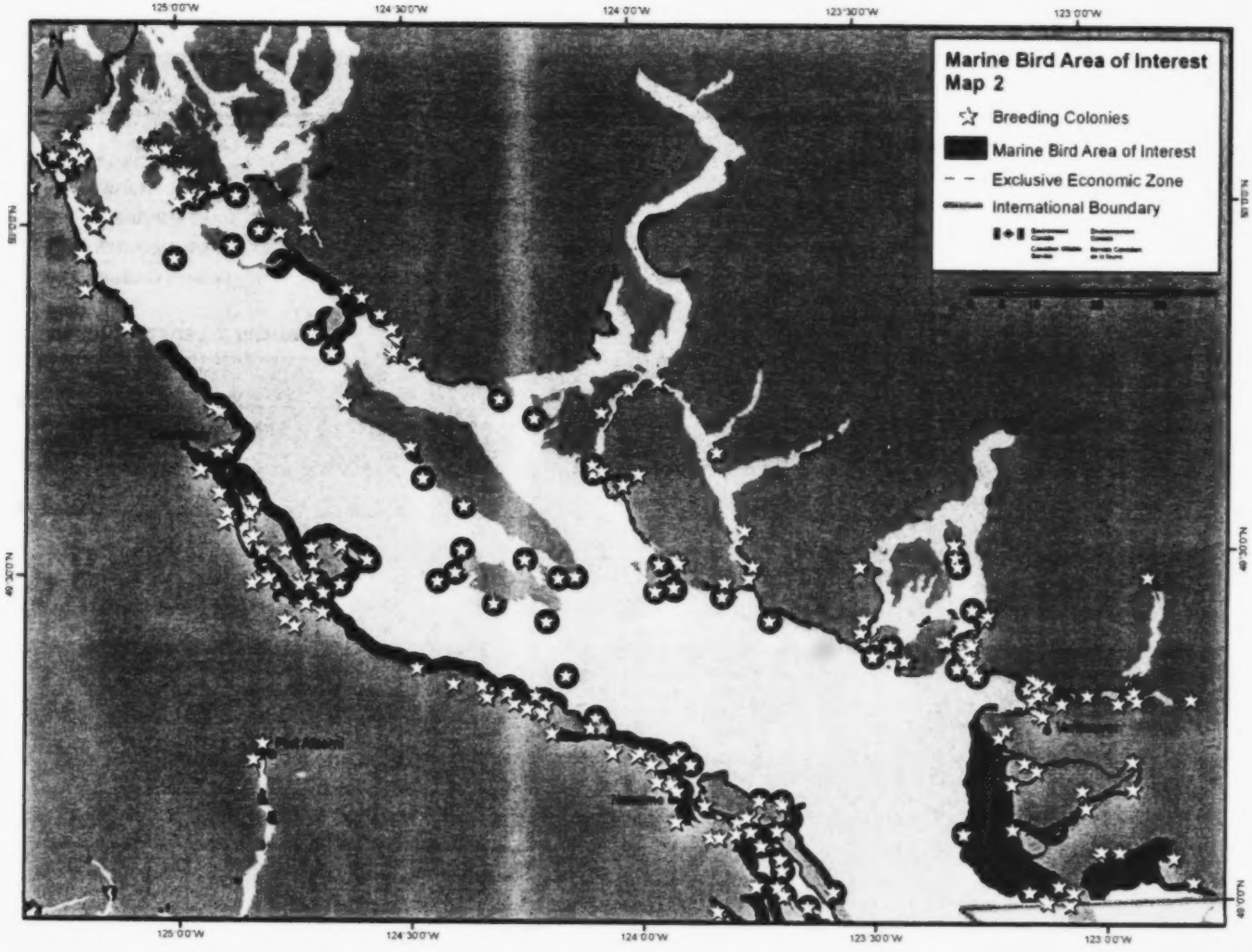


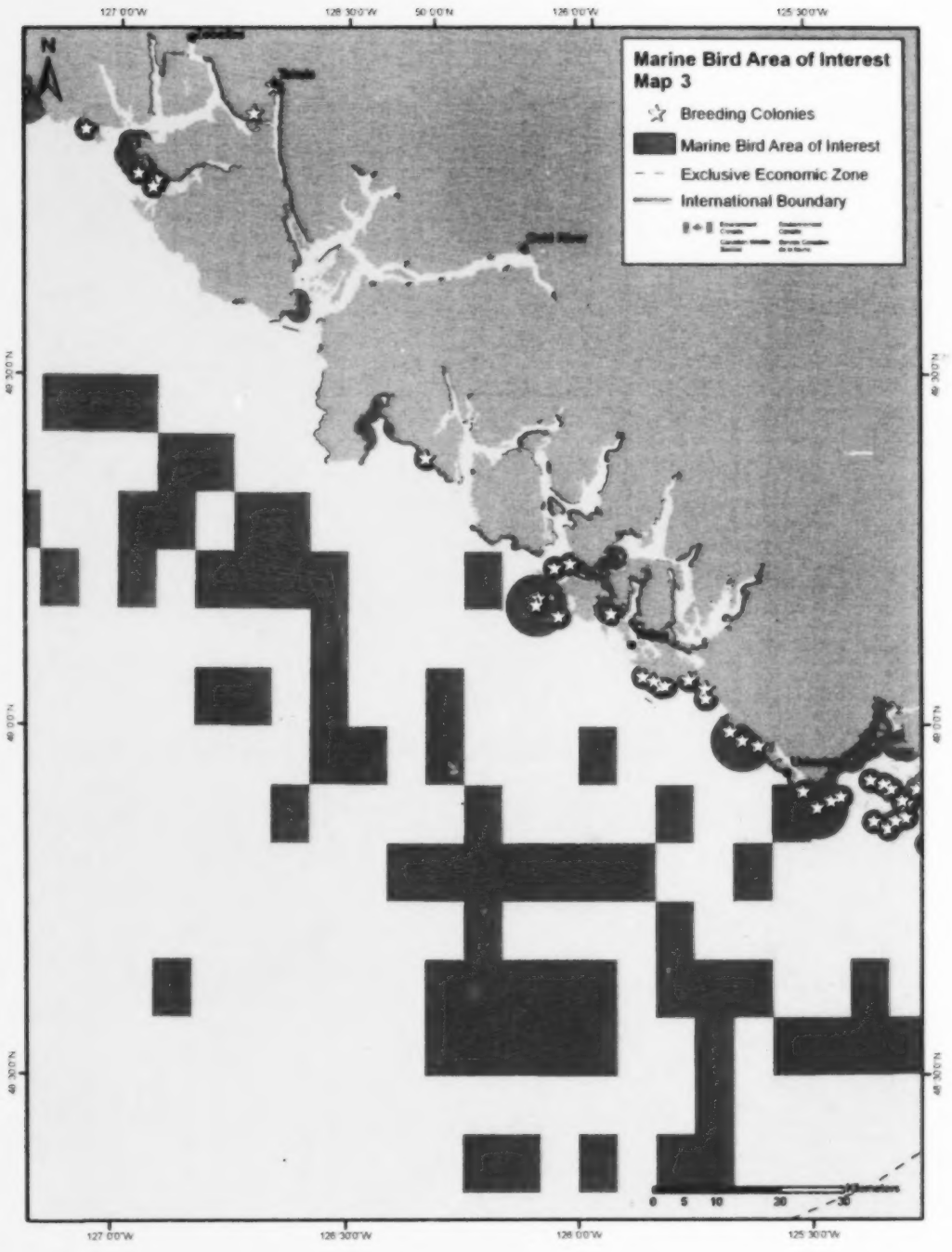
Appendix 9: Marine Bird Area of Interest Locations

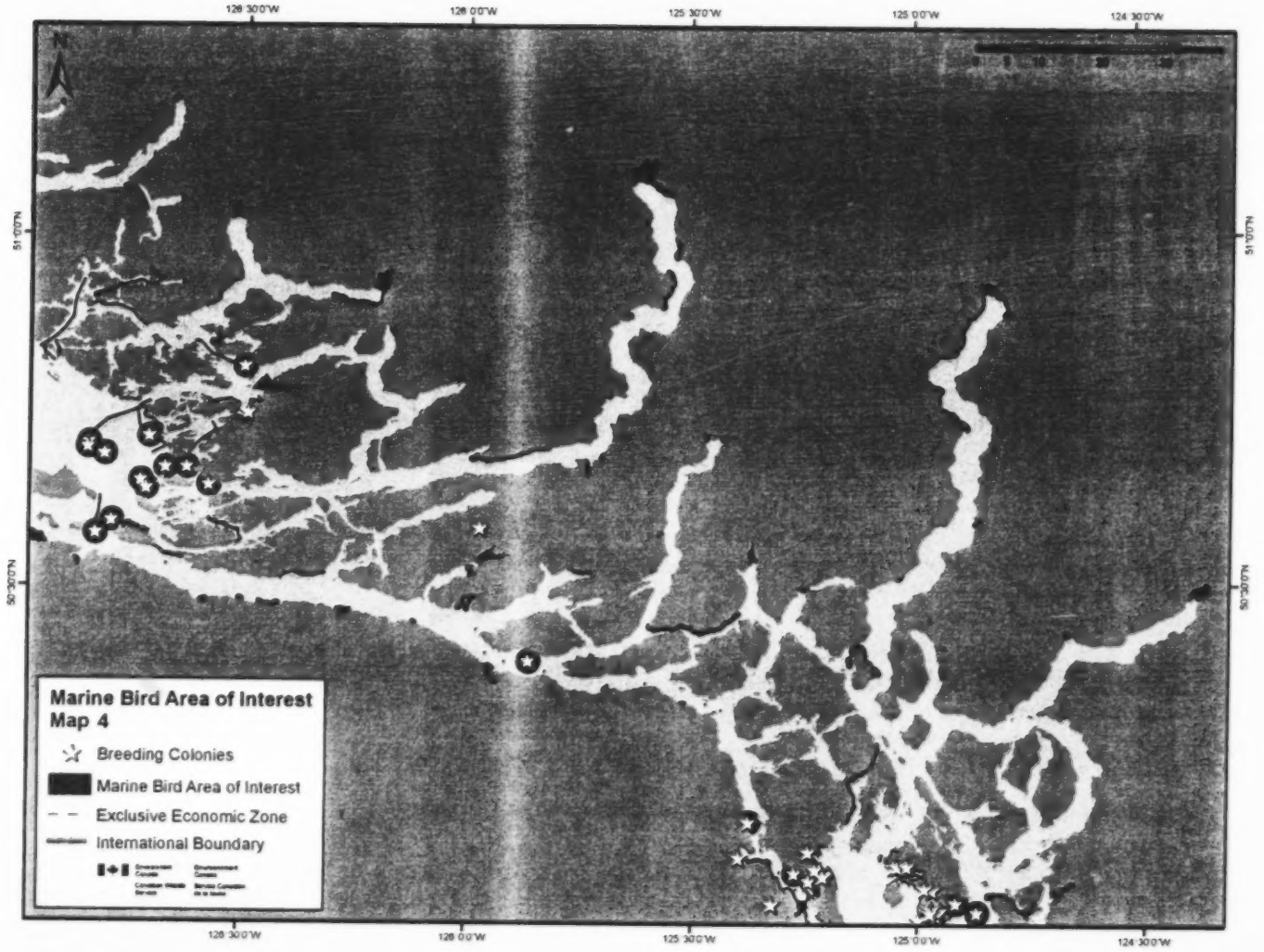
The following maps depict the location of each MBAOI. The index map can be used for ease of reference to locate a map of a region of the province. The size of an MBAOI polygon has no impact on the importance of an MBAOI as all MBAOIs are of equal importance.

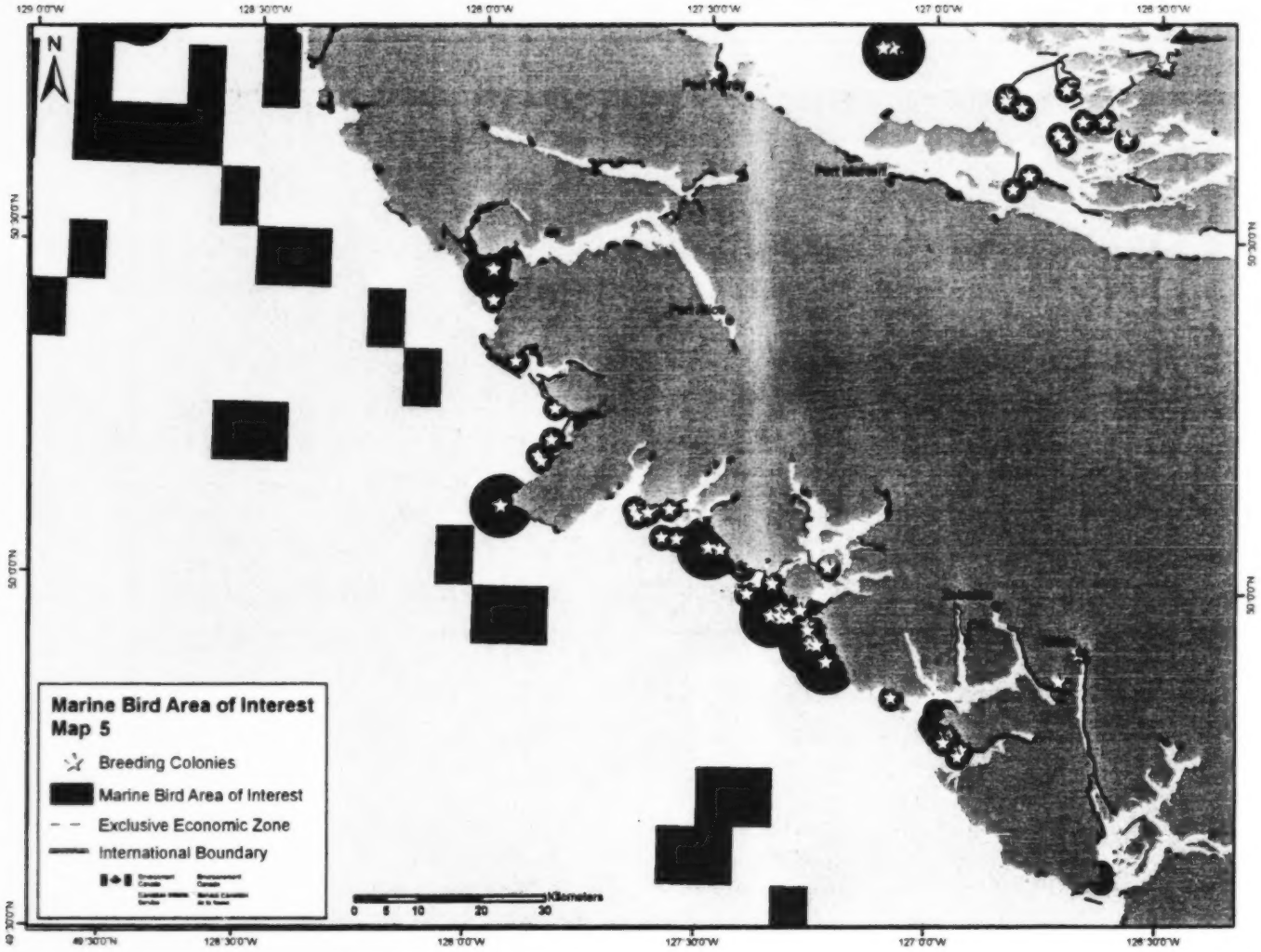

Marine Bird Area of Interest
Index map
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
N
14
13
12
11
10
8
9
7
6
4
5
2
3
1
0 30 60

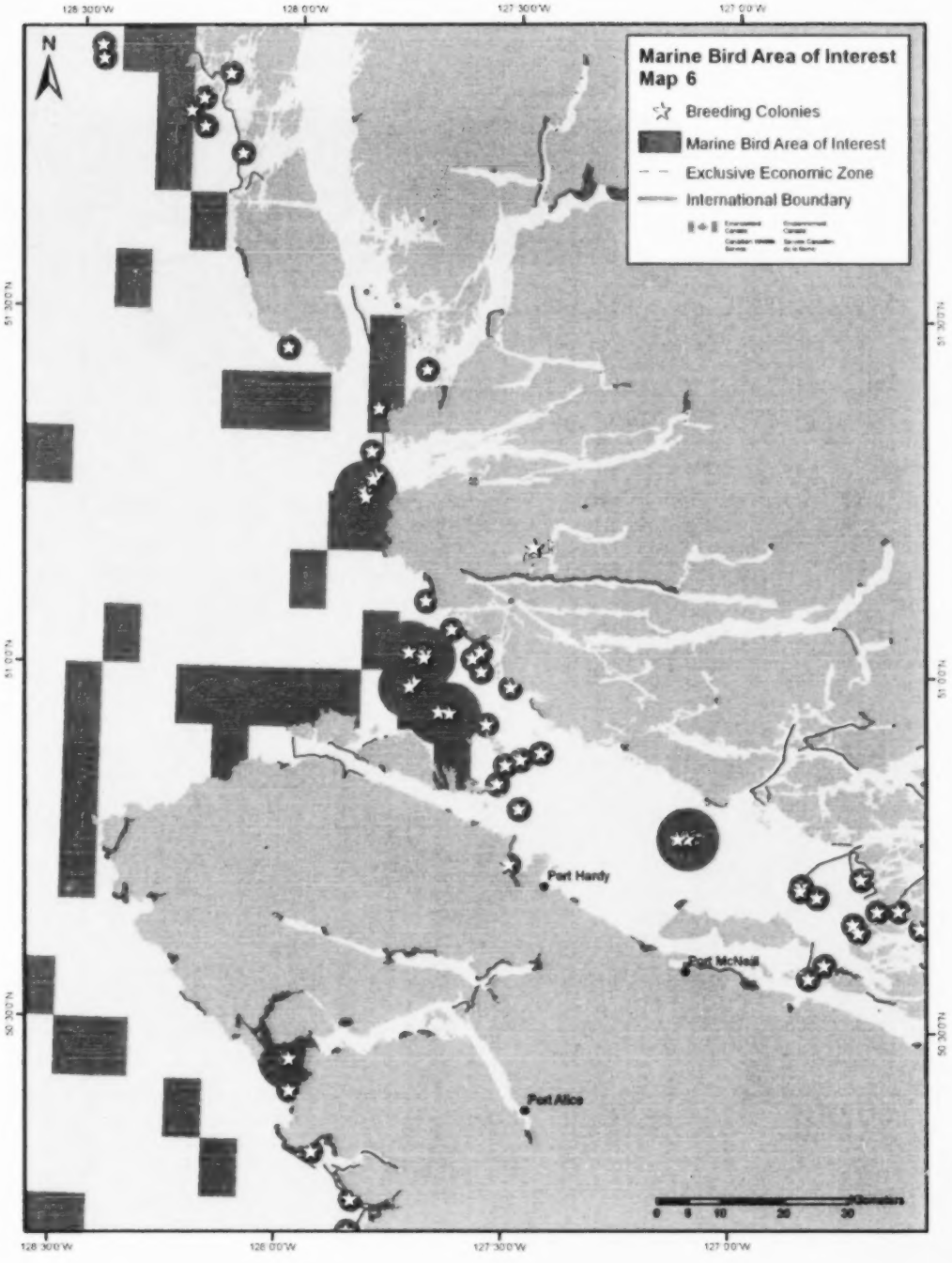

125°0'0"W
124°30'0"W
124°0'0"W
123°30'0"W
123°0'0"W
49°30'0"N
49°0'0"N
48°30'0"N
N
Marine Bird Area of Interest
Map 1
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
0 5 10 20 30

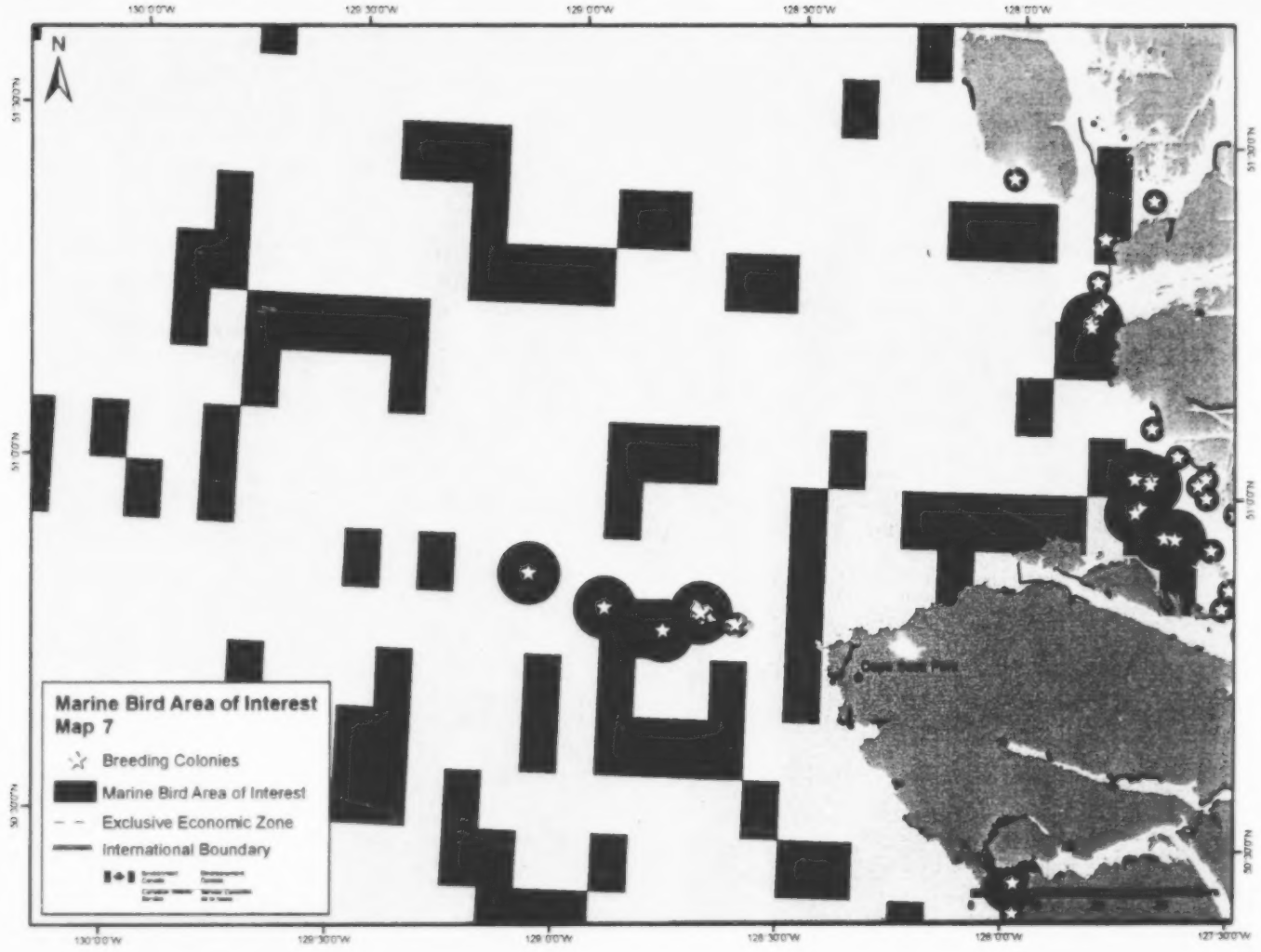

Marine Bird Area of Interest
Map 2
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
125°0'0"W
124°30'0"W
124°0'0"W
123°30'0"W
123°0'0"W
49°30'0"N
49°0'0"N

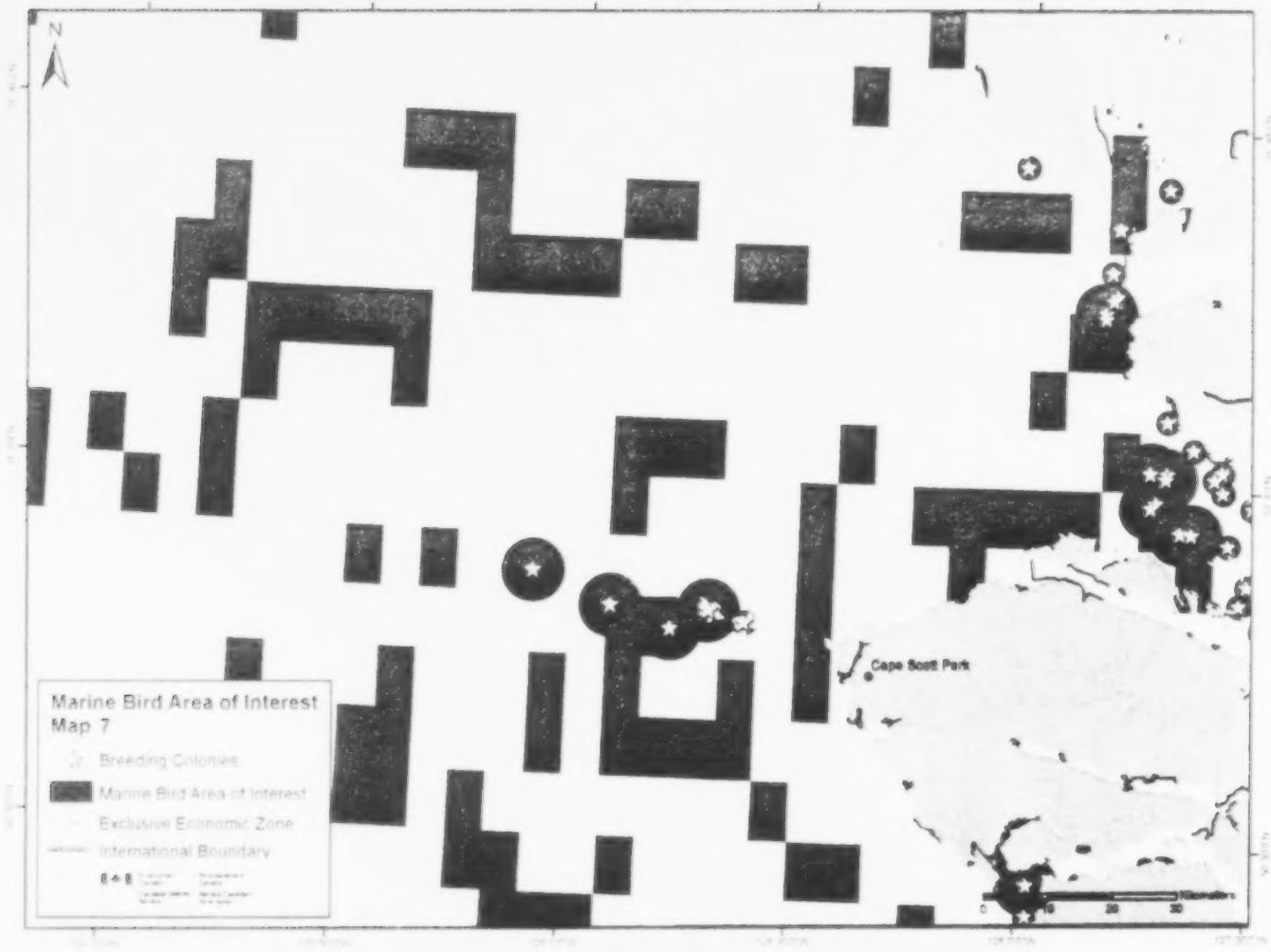

Marine Bird Area of Interest
Map 3
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
N
127 00'W
128 30'W
50 00'N
126 00'W
125 30'W
49 30'N
49 00'N
0 5 10 20 30

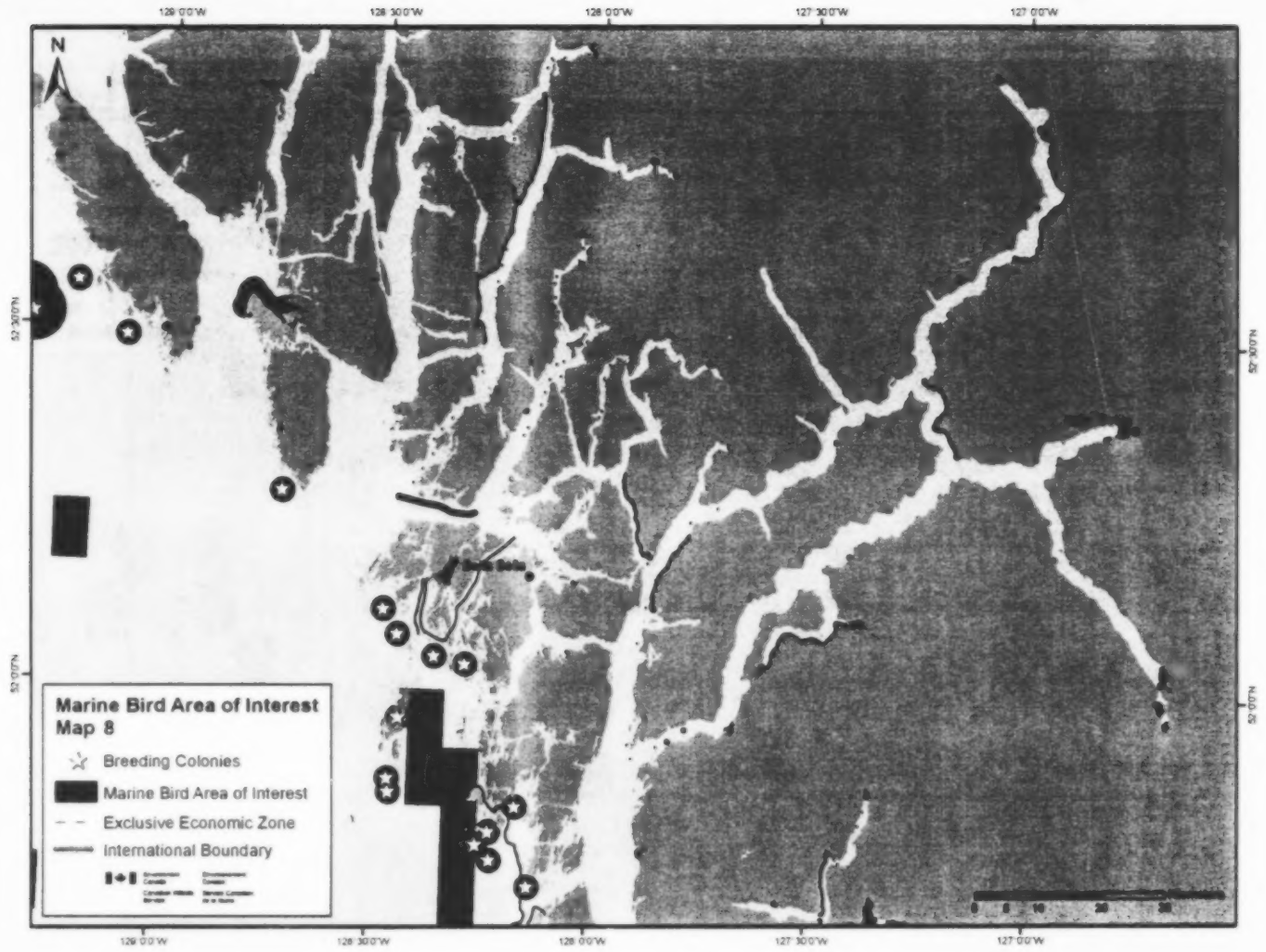

128°30'0"W
128°0'0"W
125°30'0"W
125°0'0"W
124°30'0"W
N
51°0'0"N
50°30'0"N
Marine Bird Area of Interest
Map 4
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary

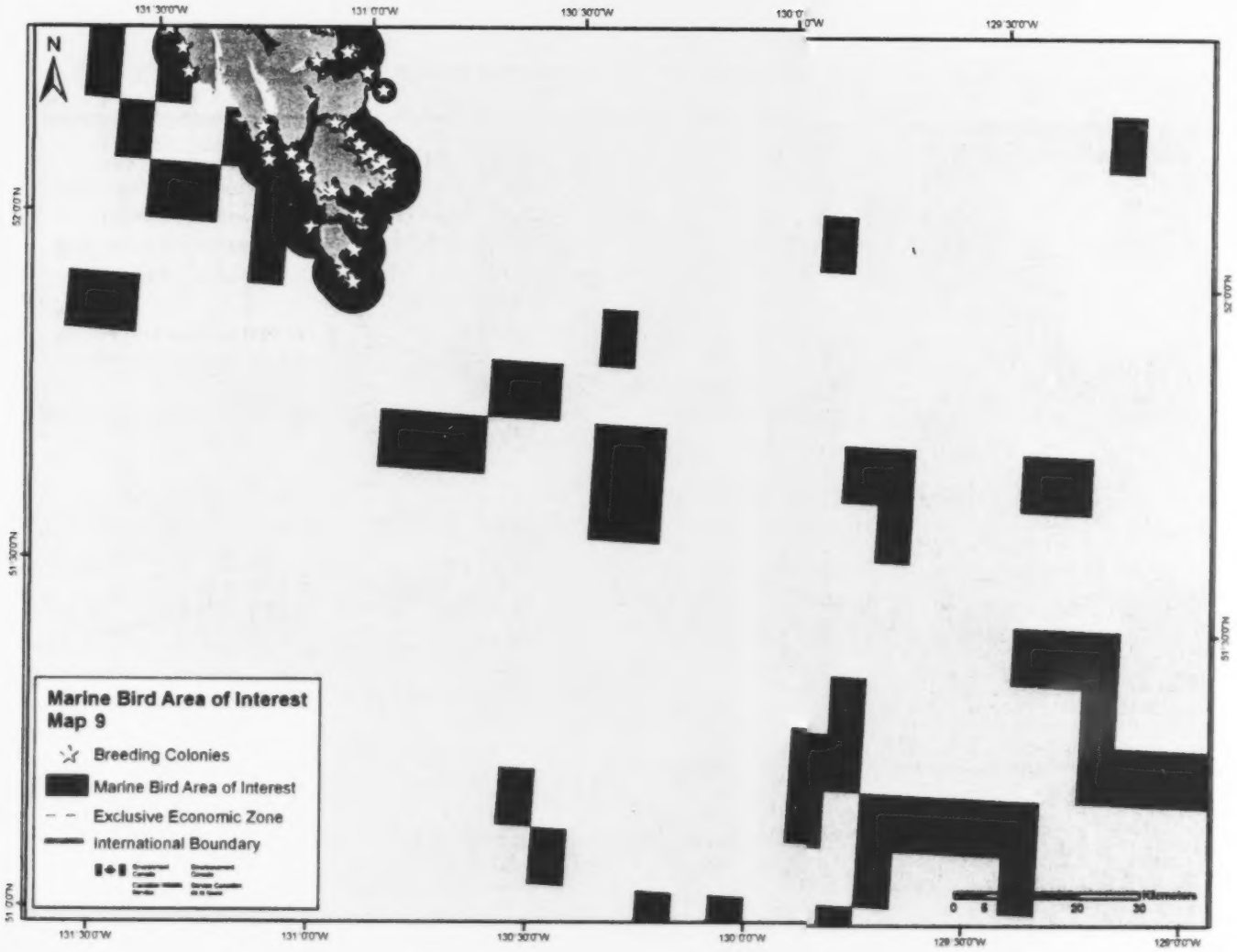

129 0'0"W
128 30'0"W
128 0'0"W
127 30'0"W
127 0'0"W
126 30'0"W
N
50 30'0"N
50 0'0"N
49 30'0"N
Port Alice
Port Hardy
Marine Bird Area of Interest
Map 5
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
0 5 10 20 30
Kilometers

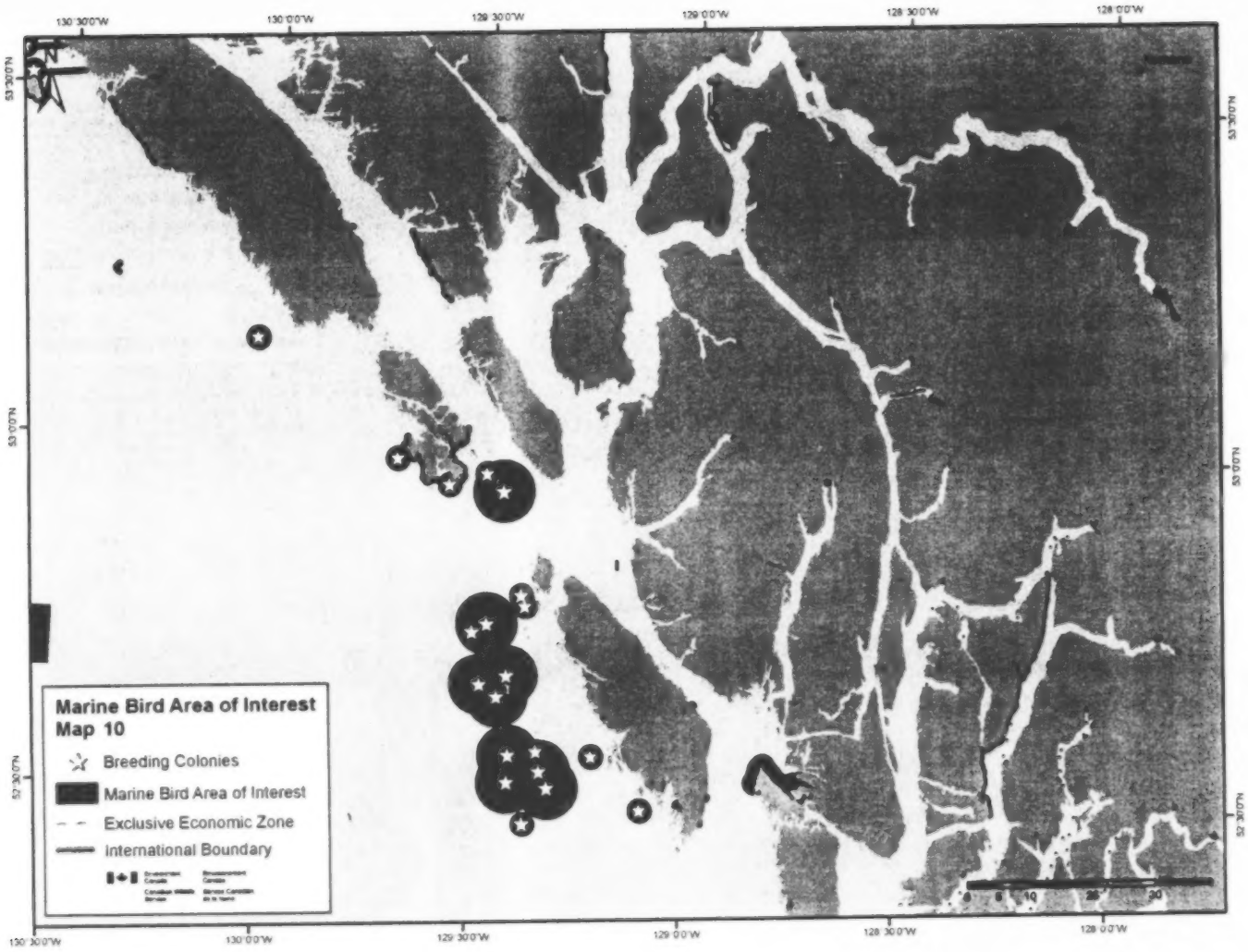

Marine Bird Area of Interest
Map 6
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
N
128°30'0"W
128°0'0"W
127°30'0"W
127°0'0"W
51°30'0"N
51°0'0"N
50°30'0"N
Port Hardy
Port McNeill
Port Alice

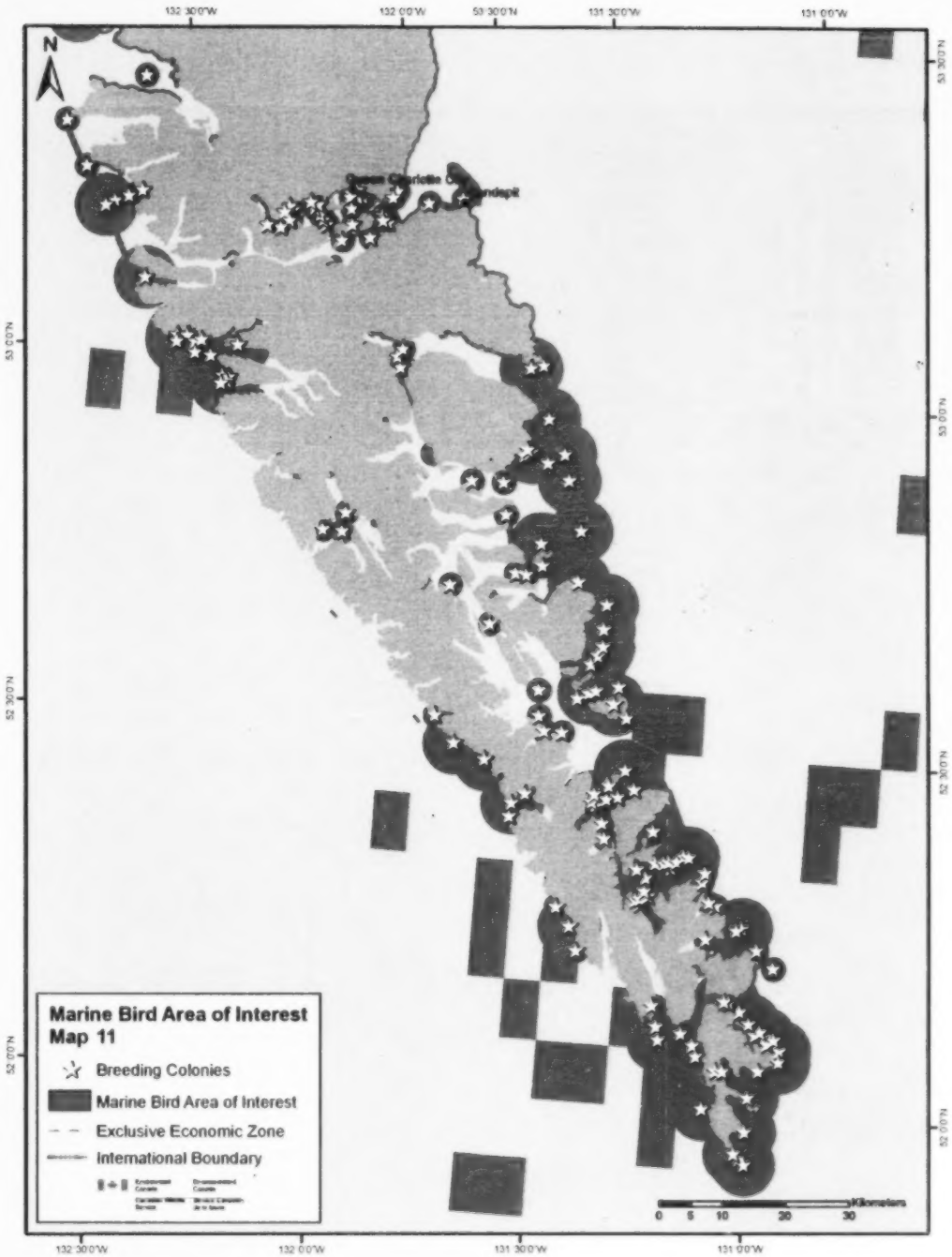

N
130°00'W
129°30'W
129°00'W
128°30'W
128°00'W
127°30'W
51°30'N
51°00'N
50°30'N
Marine Bird Area of Interest
Map 7
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary

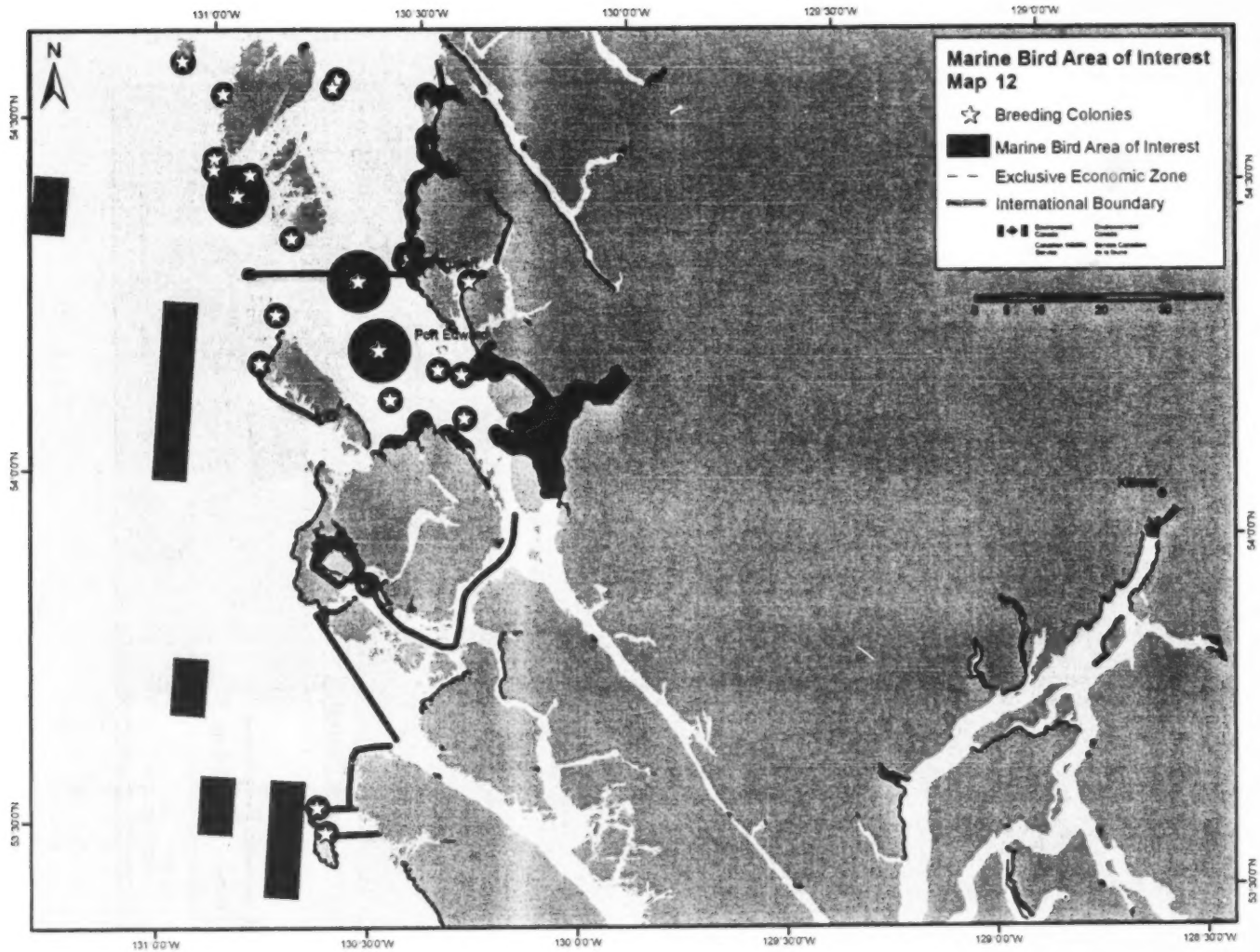

N
Cape Scott Park
Marine Bird Area of Interest
Map 7
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary

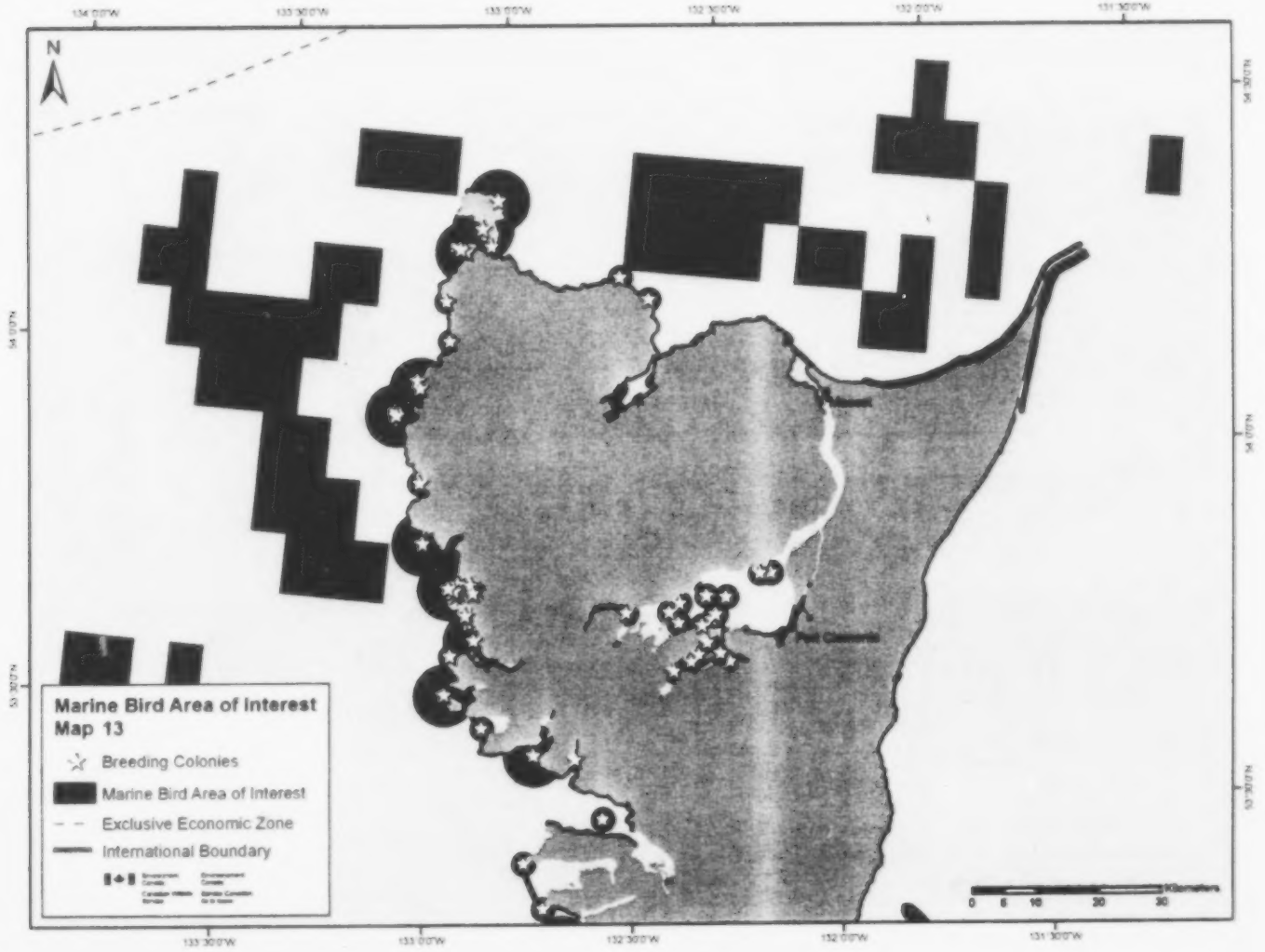

129°00'W
128°30'W
128°00'W
127°30'W
127°00'W
N
52°30'N
52°00'N
Marine Bird Area of Interest
Map 8
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary

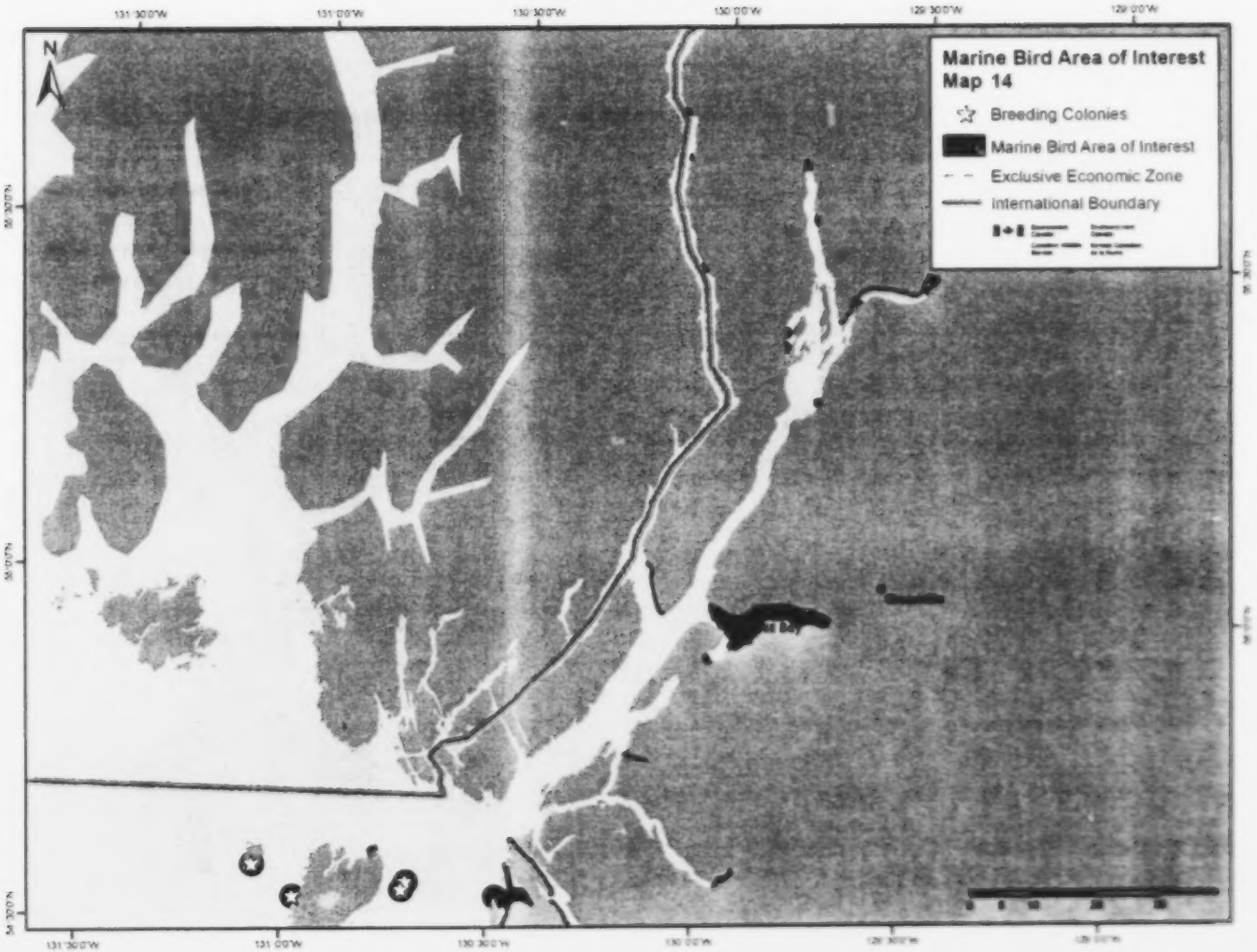

131°30'0"W
131°0'0"W
130°30'0"W
130°0'0"W
129°30'0"W
129°0'0"W
N
52°0'0"N
51°30'0"N
51°0'0"N
Marine Bird Area of Interest
Map 9
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
0
15
30
60
Kilometers


130°30'0"W
130°0'0"W
129°30'0"W
129°0'0"W
128°30'0"W
128°0'0"W
53°30'0"N
53°0'0"N
52°30'0"N
Marine Bird Area of Interest
Map 10
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
0
10
20
30


132 30'0"W
132 0'0"W
131 30'0"W
131 0'0"W
53 30'0"N
53 0'0"N
52 30'0"N
52 0'0"N
N
Marine Bird Area of Interest
Map 11
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
0 5 10 20 30
Kilometers


Marine Bird Area of Interest
Map 12
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
N
131°0'0"W
130°30'0"W
130°0'0"W
129°30'0"W
129°0'0"W
128°30'0"W
54°30'0"N
54°0'0"N
53°30'0"N
Port Edward


134°00'W
133°30'0"W
133°00'W
132°30'0"W
132°00'W
131°30'0"W
N
54°30'0"N
54°00'0"N
53°30'0"N
Marine Bird Area of Interest
Map 13
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
0 5 10 20 30
Kilometers


Marine Bird Area of Interest
Map 14
Breeding Colonies
Marine Bird Area of Interest
Exclusive Economic Zone
International Boundary
N
131°30'0"W
131°0'0"W
130°30'0"W
130°0'0"W
129°30'0"W
129°0'0"W
55°30'0"N
55°0'0"N
54°30'0"N